

PROCEEDINGS OF THE LINNEAN SOCIETY OF LONDON

149th Session (1936-7)

Part 1

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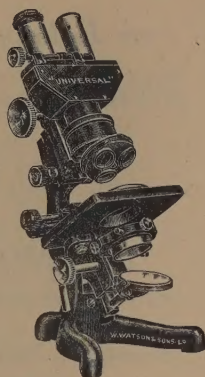
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PROCEEDINGS OF THE LINNEAN SOCIETY OF LONDON

149th Session (1936-7)

Part 1

GENERAL MEETINGS

29 OCTOBER 1936

(SPECIAL GENERAL MEETING)

Dr. W. T. CALMAN, C.B., F.R.S., President,
in the Chair

The Proceedings of the Anniversary Meeting held on Thursday, 28 May 1936, having been circulated, were taken as read and confirmed.

The President reported the deaths of Dr. Margaret Jane Benson, Cedric Errol Carr, Robert Darell Smythe Darell, Paul Kestner, Miss Clara Ethelinda Larter, Fleet-Surgeon Charles Geekie Matthew, Dr. Frederick John Freshwater Shaw, and Col. George Wingate, Fellows; and Dr. Hans Jacob Hansen and Prof. Camille F. Sauvageau, Foreign Members.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellow signed the Obligation in the Book of the Charter and Bye-Laws and was admitted:—George Edward Trease.

Certificates of recommendation of the following candidates for Fellowship were read:—For the second time, in favour of Charles Edmund Ford; for the first time, in favour of Henry Alexander Lindeman, Menie Watt, Lionel Hugh Knightley Finch, Ralph Ellis, Frederick William Andrews, Amos Perry, Terence Charles Stuart Morrison-Scott, Sir John Reeves Ellerman, Bart., Andrew William Ernest Soysa, and Brian Seymour Vesey-FitzGerald.

Issued 23 February 1937]

b

The PRESIDENT referred to Dr. Stanley Kemp's resignation of the Zoological Secretaryship; and declared the Ballot for a new Secretary (Zoology) to be open, and voting began. The Ballot was closed at 5.30 P.M., when the President appointed Professor F. E. Weiss, Mr. H. N. Ridley and Mr. A. W. Sheppard as Scrutineers.

Evidence that the Growth of the Dead-nettle, *Lamium album* L., is stimulated by the presence of the Stinging-nettle, *Urtica dioica* L.—Further observations. By Sir EDWARD B. POULTON, F.R.S., F.L.S.

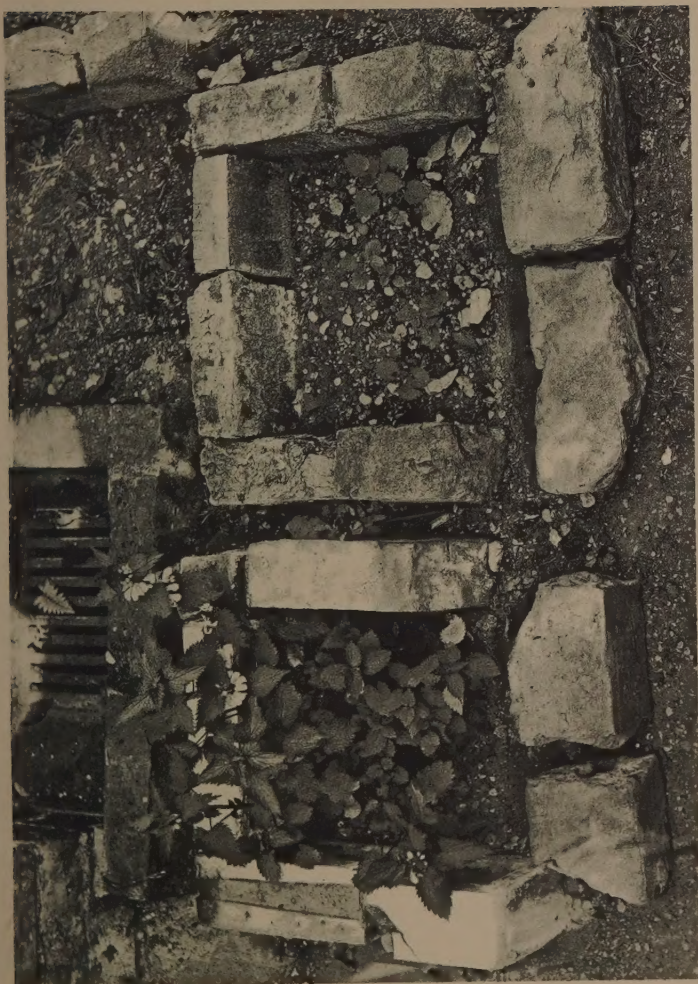
[PLATES 1 & 2]

THE results of the little experiment, described and illustrated by pl. 1 in our 'Proceedings' of 27 March 1936, have been kept under observation since the time in September last year when the photograph reproduced in the plate was taken. The contrast between the growth in the two compartments became so striking in the spring and summer that photographs shown in Pls. 1 and 2 were taken on 25 May and 20 August, respectively, efficient help being again kindly rendered by Mr. A. C. Hoyle, B.Sc., and Mr. F. A. Clinkard, of the Imperial Forestry Institute, Oxford University.

1936, *May* 25.—The photograph of this date (Pl. 1) shows a vigorous growth with four flowering stems in the left compartment which had received, on 30 July 1935, about 350 c.c. of dry earth from a nettle-bed, while the plants on the right, although very much larger than in the previous September, are small and immature with leaves very different in form and serration from those on the left. The resemblance of the latter to the leaves of the Stinging-nettle is especially well seen where they appear against the white bricks. The *Lamium* flower-buds had been observed some weeks earlier and on 16 May two open flowers on the stem in the S.E. corner of the compartment—the stem of which the flowering is the most advanced of any shown on Pl. 1.

On May 12 the results were seen by Sir Frederick Keeble, F.R.S., who concluded that the difference between the plants was not caused by the nitrogen of the nettle-bed earth. If it had been so caused, he believed that the leaves on the left would have exhibited a much deeper shade of green.

1936, *July* 12.—Eleven stems in the left compartment bore white buds or flowers. The most advanced of these had fallen and calyces were collected and dried in the hope that fertile seed had developed. In the right compartment the plants showed much growth, but with leaves immature



John Bale, Sims & Danielsson, 14 London.

EXPERIMENTAL GROWTH OF THE DEAD-NETTLE
25TH MAY, 1936.



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EXPERIMENTAL GROWTH OF THE DEAD-NETTLE
20TH AUGUST, 1936.

and less nettle-like than those on the left. The five tallest stems were from 5 to $6\frac{1}{2}$ in. in height. About five plants, one being very small, could be distinguished with some uncertainty because of the entanglement and the difficulty in deciding whether certain small low shoots belonged to any of the above five or were additional plants.

1936, *August 20*.—The photograph taken this day and reproduced on Pl. 2 shows that the flowers had mostly fallen, the calyces being clearly visible on one of the stems near the centre of the group and on another covering the tip of a fern-leaf outside the compartment. The plants in the right compartment are seen to have grown immensely since May 25, but still retain the immature more rounded leaves and show no trace of flower-buds or flowers.

The presence of a factor specially favourable to growth in the left compartment may be suggested by the grating shown in Pls. 1 and 2, together with the rain-water pipe which appears in the latter. Any such conclusion would, however, be mistaken. The enclosing bricks are cemented in place and the floor of the chamber, also cemented, slopes towards the grating. The gulley-trap below was not choked with dead leaves &c. so that the rain-water would rise and overflow. Its depth in the trap is about $8\frac{1}{2}$ in. and its surface about $7\frac{1}{2}$ in. below the level of the earth in both compartments, while the trap itself is oriented towards the right-hand one, under which the overflow-pipe runs. Furthermore, about 13 in. to the left of the bricks enclosing the left compartment is the nearly vertical, rough stone end-wall of a dry area about 5 ft. 6 in. deep. It is unfortunate that, of several pairs of compartments in which the seeds of *Lamium* were sown, successful germination should have occurred only in this pair, but I believe it has been shown that the difference in growth cannot be attributed to the rain-water discharged over the grating.

1936, *October 17*.—The tallest stems were 13 to 14 in. high in the left compartment, 9 in. in the right. Four flowering stems were noted in the former and many calyces were gathered in the hope of seed. Although still immature, the plants on the right were apparently vigorous and had grown considerably, while two shoots had pushed their way under the right bricks (on the south side) and were growing outside the enclosure.

1936, *October 28*.—A nearly prostrate stem in the left compartment was about 1 ft. 10 in. long and at least 2 ft. if stretched. Of its 10 whorls the flowers had fallen from the lower half, while the upper still bore buds or flowers, also to be seen on another stem and its branch. The little shoots outside the right compartment were about 3 in. high.

My friend Prof. A. G. Tansley, F.R.S., has kindly examined the seeds and reports that 'none were viable. Of the batch marked July 12 not one had even formed an embryo; of the October 17 batch, one, and one only, had a fully formed embryo, but it was dead'.

It is probable that the little patch of *Lamium* in an enclosure only 9 in. square had been passed over by the humble-bees which would have brought about cross-fertilization.

The contrast between the plants of the right and left side, shown in pl. 1 of Proc. Linn. Soc., 148 Sess., 1935-36, and in the two Plates of this paper, is so great and has persisted for so long a time that the influence of a living organism, of which the germs were introduced with the nettle-bed soil, is suggested—a possible conclusion pointed out to me by Mr. Ray Bourne, Demonstrator in the Imperial Forestry Institute, Oxford University, who has kindly directed my attention to the apparently analogous effect produced by mycorrhizal fungi upon seedlings of *Pinus* as shown by the experiments of Dr. M. C. Rayner and others*.

Friends who have read the earlier paper on this subject have kindly written of their experiences, especially valuable when gained by Hymenopterists who have been interested in the visits of Humble-bees to the flowers of *Lamium*.

Dr. R. C. L. Perkins, F.R.S., writing on 27 May 1936 from Newton Abbot, contributed the following interesting notes:—

'White dead-nettle is quite rare here, and I have not seen the Red one at all. I only know two spots where *L. album* grows near me—though of course there must be others. One is on a waste patch of land by the canal half a mile from the house, and I have seen this patch every year for fully 10 years. On many occasions I have visited it to pick the fresh growth in April (or even March) as food for the hibernated larvae of the two tiger-moths, *Callimorpha hera* L. and *C. dominula* L. I also use it for them in the autumn when they

* M. C. Rayner, 'Mycorrhiza, an account of non-pathogenic infection by fungi in vascular plants and Bryophytes', 'New Phytologist Reprint', no. 15, 1927.

'Empire Forestry Journal', ix, 1930, pp. 182-9; Brit. Assoc., Sect. K, 1930, 1931, 1932, Repts. of Comm. on *Mycorrhiza* drawn up by M. C. R.; 'Forestry', viii, no. 2, 1934, pp. 96-125, pls. v-xiii; x, no. 1, 1936, pp. 1-22, pls. i-vi.

S. L. Kessell, Conservator of Forests, Western Australia, 'Empire Forestry Journal', vi, no. 1, 1927, pp. 70-4, figs. 1-3.

E. J. Kelly Edwards, Acting Chief Forest Officer, S. Rhodesia, Rept. Dept. Agric. S. Rhodesia, 1930, p. 53.

J. B. Clements, Conservator of Forests, Rept. For. Dept., Nyasaland, 1934, p. 17.

D. A. N. Cromer, B.Sc., Commonwealth For. Bureau, Bull. no. 16, Canberra, 1935, pp. 1-19, pls. 1-6, figs. 1-3.

first hatch and until they hibernate. It is an admirable food, as it produces large moths and without bringing disease to the larvae. I have never yet picked this food without getting well stung on the hands by the true nettles with which it is mixed. There are many clumps of nettles on this waste land, but only the one of dead-nettle. I have just been down to look at the place. The nettle and *Lamium* are well mixed and anyone long-sighted like myself and not wearing glasses out of doors would be certain to be stung in picking the latter. The patch is about 9 yds. long, of a curved form with a tendency to spread on one side.

I seem to remember that *Lamium* used to be distributed all over the place alongside hedges &c. in Oxford and in the Cotswold district. In both these areas in the spring I used to look for the big queens of *Bombus latreillellus* on the flowers, and those of *B. derhamellus* (using the old names of E. Saunders) were abundant. The former is very rare here, the latter uncommon, and it is curious that the only ♀ of *latreillellus* I have seen here, I caught on that waste land and I notice a ♀ *derhamellus* there most years. It would be too much to say they were there because of the *Lamium*, as they are not at all confined to it in the spring.

The other patch of dead-nettle is about $\frac{1}{4}$ mile from the one mentioned, but with the river Teign between and less accessible, so I have seen it only infrequently. It has now disappeared and I cannot remember whether it was associated with stinging-nettle.

Dr. O. W. Richards, D.Sc., wrote 10 May 1936 on the same subject :—

"It is certainly a very interesting problem. I have always been observant of *Lamium album* because it is the flower most attractive to *Bombus*. My experience is the same as yours, that it always occurs amongst or near nettles."

Two friends have also brought evidence that the dead-nettle, when found apart from the stinging-nettle, is growing in places where the latter has recently existed.

Mrs. D. R. Fyson, of Laugharne House, Rushwick, Worcester, wrote on 20 May 1936 :—

"Such evidence as our garden affords bears out your theory. The place was neglected when we took it, four years ago, and one of the first tasks was to root out nettles. On the site of the chief nettle-beds there are now prosperous clumps of dead-nettle, whose white flowers are so fine that I leave them undisturbed where they do not interfere much with other plants."

Mrs. F. Ll. Griffith, of Sandridge, Boars Hill, Oxford, has also informed me that her experience of *Lamium* in the

garden of Sandridge, where stinging nettles had recently flourished, is precisely the same as that of Mrs. Fyson.

Professor F. E. WEISS expressed his appreciation of Sir Edward Poulton's experiments and his interest in the results obtained. He thought the soil from the bed of nettles which had been added to one of the plots might in some way have enriched the plot. He had therefore started an experiment in which two plots containing the same soil had been sown with seeds of *Lamium album*. In one of the two, however, he had planted rhizomes of the stinging-nettle in order to see what influence, if any, it might exert upon the seedlings of the dead-nettle.

Mr. I. H. BURKILL referred to the very rapid recovery of fertility in a seed-bed after partial sterilization by fire, and asked if it were not possible to explain the success of the dead-nettle plants on the soil inoculated from the stinging-nettle patch as the work of a somewhat selected soil fauna on a soil which was sterile at the beginning of the experiment.

Studies in Linnaean synonymy. 2. Sir James Edward Smith and the Linnaean herbarium. By S. SAVAGE, F.L.S.

My intention was to have made the second of these Studies one on how Linnaeus dealt with the British flora in connection with the first edition of the 'Species plantarum'; but illness has prevented me from carrying out the necessary detailed work. However, chance brought to my hand a discovery that enables me to fill the gap. This summer when Dr. A. H. Uggla of the Royal University Library, Uppsala, had finished his second investigation of the Linnaean MSS., I suggested to him that I should begin a catalogue of the annotations in printed books in Linnaeus's library, as likely to be of use to him for the Catalogue of Linnaeus's Manuscripts towards which he is now working. It was during this work that I came upon the book which is the subject of the present paper.

In an inconspicuous position at the end of one of the shelves in Linnaeus's library I found a copy of the 'Systema vegetabilium', ed. 14, by J. A. Murray, 1784, labelled on the back by some careless person edition 13. Like several other books in Linnaeus's Library, this volume was added to it by Sir James Edward Smith. It has Smith's inscription on the front fly-leaf: *Novr. 1784. Ex dono Illustr. Banksii*. When I saw that it bore throughout ticks and other markings, I made a careful examination. On p. 50 I found a pencil note by Richard Kippist, who was in the Society's service from 1830-80: ✓ indicates that there is a specⁿ in the Linnean Herb^m (R. K.). That might lead one to suppose that Kippist

was responsible for the ticks and other markings; but a close scrutiny of these in conjunction with many annotations by Smith † leaves no doubt that the pencil markings and annotations belong mainly to the years 1784–5 and the ink annotations to about the year 1792 when the book was used again by Smith to record new genera.

In addition to ticks, Smith used also the $\times$ sign, and it was some time before I was able to decide on its meaning. Some of these $\times$ signs were no doubt added later than 1784, and they were used by Smith to indicate that he had the species in his own herbarium. In a few instances the + sign is used in connection with species; further, at the end of some genera it is used to indicate that there are still some unidentified species; e. g. +*multa*, +3, etc.

A careful study of the markings and annotations in this copy of the 'Systema vegetabilium', 1784, has convinced me that here is Sir James Edward Smith's record of the Linnaean herbarium as it came into his hands from Sweden.

The Linnaean Collections arrived in London at the end of October 1784, and during the ensuing seven months a careful comparison of the Linnaean and Banksian plants was carried out by Banks, Dryander, and Smith ‡. Occasionally in the Linnaean herbarium will be found a plant given to Smith by Banks; on the sheets these have been carefully noted as such by Smith. On the other hand, in a Smithian MS., *Desiderata Banksiana*, Jan. 1785, are recorded 83 specimens given by Smith to Banks from the Linnaean herbarium on 9 Feb. 1785 §.

I will now state briefly a few conclusions arrived at by a study of this newly-discovered enumeration of the Linnaean herbarium:—

1. The species ticked are those which Banks, Dryander, and Smith agreed were the plants described by Linnaeus. So far as I have at present checked, where a specimen is written up on the sheet by Linnaeus but is not ticked by Smith, a pencil note by Smith will be found on the herbarium sheet which will account for the non-acceptance of the Linnaean specimen.

2. The vexed question of what are the Linnaean type-specimens did not enter into the investigation. All three

† Against some of the entries Smith has written HB [= Herb. Banksii]; at p. 110: *confirmatate Herb. Banksii*; at p. 746, a reference to Herb. Cliff.; etc.

‡ 'Lachesis lapponica' (London, 1811), preface, p. ix; Mem. & Corresp. of the late Sir James Edward Smith, vol. i, 1832, p. 127.

§ See Appendix to this paper.

investigators were good botanists, capable of comparing exactly a plant with the Linnaean diagnosis, but like stamp-collectors comparing stamp-albums, their interest extended only to settling whether or not a particular Linnaean species was present. Nevertheless, one of the merits of the enumeration is that it gives a critical opinion on the Linnaean plants by three good botanists only six years after Linnaeus's death †. It should not be forgotten that the Linnaean specific diagnoses were founded on differences within genera that were constituted upon an artificial system now superseded.

3. There are considerably more specimens of the plants of the 'Supplementum plantarum' noted in Smith's enumeration than in Dr. Jackson's 'Index'. The basis upon which Dr. Jackson prepared his 'Index' was responsible for these omissions. Petermann's Index to Richter's 'Codex Linnaeanus', from which I copied out the Linnaean names to serve as a basis for Dr. Jackson's work, did not include any of the new names of the 14th edition of the 'Systema vegetabilium' ‡. Smith has not only marked the 'Supplementum' species, but also some that refer to the younger Linnaeus's Dissertation on Mosses; and, in addition, where plants were recognised as species described by Jacquin, Thunberg, and others, the entries have been ticked.

4. A restricted test shows that Smith re-arranged the species in the Linnaean herbarium in the same order as that of the 14th edition of the 'Systema vegetabilium'.

5. The species in monotypic genera are either accepted or rejected. In Dr. Jackson's 'Index' such specimens that do not bear the specific name written by Linnaeus have only the abbreviation pl. [plant] against them.

† Nevertheless, Smith soon became well acquainted with the relative values of the Linnaean specimens, as the following passage in his letter to T. J. Woodward on 30 March 1786 proves:—'I have now learned to decypher almost all his [Linnaeus's] marks in the Herbm, & having gone through the whole with Sr J. Banks am quite master of it. I now know which are the specimens from which he originally described species, & which are acquired since, the places each came from &c. &c., consequently know which are decisive authority & which not.'

‡ I would here modify a statement in the preface to Dr. Jackson's 'Index' (p. 8) that in the MS. of the 'Supplementum' 'the early part has been copied by another hand, and practically none of it remains in the handwriting of Linné'. This, in a paragraph dealing generally with the 'Supplementum' species, is misleading. The imperfect MS. of the 'Supplementum' is certainly in part in the handwriting of an amanuensis, but it also contains a considerable amount both in the handwriting of Linnaeus and of the younger Linnaeus. The handwriting of Linnaeus in this MS. is scarcely recognizable at times as his, but it belongs to his final period of work, after his apoplectic stroke. Moreover, the work of the amanuensis has been corrected in places by the elder Linnaeus.

6. The question arises, what was, and where is, the herbarium of the younger Linnaeus? In a document left by Linnaeus for the guidance of his wife after his death, he refers to 'the two herbaria in the museum . . .' and says 'my son should not have them . . .'. After the younger Linnaeus's death in 1783, a small collection of plants called *herbarium parvum* was not included with the Collections purchased by Smith (Jackson, Linnaeus, p. 347), but went to Baron C. Alströmer in settlement of a loan made to the younger Linnaeus. Professor J. G. Acrel appears to have been responsible for the statement that this small herbarium was the youthful herbarium of the younger Linnaeus. (Letters to Smith, 6 March and May 1784, Mem. & Corresp. of the late Sir James Edward Smith, vol. 1, 1832, pp. 99, 104). But if this herbarium had belonged to the younger Linnaeus, would his father have left instructions as to its disposal? This small collection, no doubt the second herbarium mentioned by Linnaeus, is preserved to-day in the Natural History Museum, Stockholm; it contains some duplicates from the elder Linnaeus's herbarium as well as some of the younger Linnaeus's plants, including some of those received from Sir Joseph Banks. It would seem possible that the contents of this small herbarium became changed during the work that the younger Linnaeus did in caring for his father's herbarium and also later, after his return from abroad. The elder Linnaeus may have used it for duplicates which he did not wish to place in his main herbarium, to be used for exchanges or presents. The younger Linnaeus had scarcely time before his death † to put in order all the plants he had received on his travels abroad, with the result that many of these plants did not get laid in either herbarium, and were included as belonging to the Collections sent to London ‡. Many of these plants must be among those found to-day in Smith's herbarium as coming from the herbarium of the younger Linnaeus. The plants of the younger Linnaeus are, therefore, now in three different herbaria, for in carrying on his father's work he placed many of his own type-specimens of the 'Supplementum plantarum' in the Linnaean herbarium.

7. Smith's enumeration is a witness to the care that first he and then this Society have taken of Linnaeus's herbarium, for so far I have not found any evidence of missing type-specimens.

† He reached Uppsala in February 1783 and died on 1 November of the same year.

‡ 'The Herbarium of old Linnaeus is in perfect order, that of his son is not arranged.' Letter from Smith to T. J. Woodward, 27 Jan. 1785.

APPENDIX.

List of plants from the Linnaean Herbarium given by Sir James Edward Smith to Sir Joseph Banks, as recorded in the MS. 'Desiderata Banksiana' [Smith MSS. 39, 62], on 9 February 1785.

[Note.—An asterisk is added to names first published in the 'Supplementum plantarum', 1781.]:—

Gratiola hyssopioides.
Utricularia gibba.
 — *cærulea*.
Ixia pentandra *.
Gladiolus falcatus *.
Commelina vaginata.
 — *nudiflora*.
Cyperus pumilus.
Scirpus Luzula.
 — *hottentottus*.
 — *antarcticus*.
Avena purpurea *.
Aristida arundinacea.
Hedyotis maritima *.
 — *pumila* *.
Spermacoce stricta *.
Oldenlandia repens.
Lithospermum disperm.
Campanula tenella *.
Chiococca paniculata *.
Thesium scabrum.
Erica nigrita.
 — *albens*.
 — *corifolia*.
 — *comosa*.
Weinmannia tomentosa *.
Melastoma grossa *.
 — *strigosa* *.
Andromeda anastomos *.
Arbutus ferruginea *.
Cucubalus sibiricus.
Arenaria triflora.
Oxalis sessilifolia.
Spiræa argentea *.
Ternstroemia meridion *.
Alstonia theæformis *.
Vallea stipularis.
Brathys juniperina.
Drimys granadensis *.
Teucrium salicifolium.
 — *pumilum*.
Nepeta ucranica.

Scrophularia frutescens.
Premna serratifolia.
Cheiranthus strictus *.
Heliophila pusilla *.
 — *flava* *.
Brassica vesicaria.
Bunias myagroides.
Polygala æstiuans *.
Aspalathus genistoides.
 — *nigra*.
 — *argentea*.
Galega cærulea *.
Chrysocoma biflora.
Athanasia genistifolia.
 — *pubescens*.
Artemesia Santonicum.
Gnaphalium arenarium.
 — *helianthemifol*.
Conyza decurrens.
 — *chinensis*.
Tussilago anandria.
Cineraria americana *.
Bellium minutum.
Hippia minuta *.
Stoebe scabra *.
Lobelia anceps *.
 — *debilis* *.
 — *bellidiflora* *.
Ophrys bracteata *.
 — *bivalvata* *.
 — *caffra*.
Ægopricon betulinum *.
Carex baldensis.
Serpicula verticillata *.
Amaranthus scandens *.
Salix ægyptiaca.
 — *rosmarinifolia*.
Viscum purpureum.
Juniperus chinensis.
Mimosa Senegal.
Onoclea polypodioides.

[At the end of the MS., Smith has written 'Feb. 9th communicatæ ex HL patris 81'. The number marked, however, is 83.]

Mr. J. RAMSBOTTOM said that the communication to which they had just listened was further evidence, if such were needed, of the great interest Mr. Savage took in the Library under his charge, and of the great knowledge he had of

Linnaean matters: it needed considerable alertness to have discovered the significance of markings described in a misleading manner, in an oddly placed book wrongly labelled. The Society was fortunate in having in its service one who cherished its historical treasures so abundantly. It was a matter of some interest to himself to have a list of the specimens given to Banks by Smith.

Mr. E. G. BAKER stated that he was much interested in the types of Linnaeus fil., and asked for the names of the different herbaria where these were to be found. He mentioned that sometimes—as, for example, *Hibiscus micranthus* Linn. fil.—plants collected by Koenig were at South Kensington. Koenig was the collector mentioned by Linnaeus fil. for this species †.

Preliminary account of the breeding changes in the skulls of *Salmo* and *Oncorhynchus*. By Dr. V. TCHERNAVIN.

THE present account summarizes some of the results of my study of the changes in the skull of different Salmonini.

The changes during the individual life of a salmon are so striking that I think they have an outstanding biological interest.

The skeleton of an adult vertebrate is usually regarded as one of the most stable parts of the animal body, but, studying the skull of an adult salmon, we see that it alters throughout the whole life of the fish. These alterations are so important that the study of the salmon skull comes in reality to a study of its changes.

There are two different kinds of processes of changes in the salmon skull. The first are those which originate in the continuous growth of the fish, which does not stop with the maturity of the organism. This growth is not a simple enlargement in size, proportional in every one of its parts, but a more complicated process, for the rates of growth are different in different parts of the skull, and therefore with the enlargement of the fish the skull gradually changes its proportions, i.e. its shape. The changes of this category have only a positive phase: all parts subject to this process *increase in absolute size*.

The second process of changes in the salmon skull is connected with periods of the ripening of the roe, and has two phases. The first phase is positive; during this phase many parts of the skull rapidly *increase in absolute size* with the result that the skull changes its size, proportions, and form. The culminating point of this phase coincides with the time

† [Koenig's specimen, the younger Linnaeus's type, is in the Linnaean Herbarium.]

of spawning. After the spawning the second or negative phase of this process takes place; all newly grown parts now *decrease in absolute size* and the skull resumes its former size, proportions, and shape, though perhaps, not exactly.

Both these processes of change work in a very complicated manner on different bones and cartilages. Often the same bone is subject to one or to both of these processes at different rates in its different parts, and even in the same part with different rates in different directions. This fact makes a clear understanding of these processes very difficult, and we have to organize our study in such a way that both of the processes can be considered separately.

Here I shall speak only of the process of the *breeding changes*. I studied these changes quantitatively, and elaborated for this purpose a special method, into the details of which I will not enter here, but will give only a general picture of the breeding changes in the Salmonini skull.

There are two different types of breeding changes in the Salmonini. One, which reaches its highest development in the *Salmo salar*, is also present in all migratory species of the same genus, e.g. *S. trutta*, *caspicus*, etc. (Atlantic); *S. irideus*, *gairdneri*, etc. (Pacific); and in species of the genera *Salvelinus* and *Hucho*. The second type of breeding changes occurs only in the Pacific genus *Oncorhynchus* (as determined by Suckley and Günther), including species *O. keta*, *gorbuscha*, *tschawytscha*, *nerka*, *masu*, and *kisutch*.

THE FIRST OR *SALMO* TYPE OF BREEDING CHANGES.

Considering this process in *Salmo salar*, I divide its metamorphosis into five stages:—

During the *first* the influence of sexual development is not shown at all. At this stage the fish is on its feeding grounds in the sea. During the *fourth* stage the breeding characters are in their full development and the fish spawns. In the *fifth* stage the breeding stages disappear. The *second* and the *third* are two typical moments in the sexual development.

Changes in the chondrocranium.—The chondrocranium in the *Salmo* skull is well developed and retains its independent significance throughout the whole life of the fish. The main parts of the chondrocranium are unossified, and the larger the fish the larger are these cartilaginous parts, not only absolutely but also relatively, a phenomenon which can seem quite paradoxical. Typical for *Salmo* is that the fore end of the 'rostrum' is forked and terminates in two 'horns', to which are fastened the labial cartilages. These 'horns' and labial cartilages are overlapped by the fore ends of the premaxillaries and fit into the 'pockets' on the inner surface of the latter.

In the first stages of sexual development the 'rostrum' is short, and in general outline has the shape of a pyramid, the apex of which is directed forward. A straight line traced from the upper surface of the anterior end of the 'rostrum' to the fore end of the super-occipital almost coincides with the upper surface of the skull, but cuts through part of the frontal cartilage. A similar line traced from the same anterior point to the hinder end of the ethmoid wing coincides with the upper surface of the ethmoid region.

Quite different is the skull of a male in the fourth, or breeding, stage of sexual development. At this stage the 'rostrum' is immensely lengthened and is much deeper and wider; all the facial region is greatly curved, its fore part growing upward; and the whole skull becomes saddle-shaped. A straight line traced now from the fore end of the 'rostrum' to the super-occipital bone passes far above the upper surface of the skull and does not touch the frontal cartilage. In a similar way the line traced from the fore end of the 'rostrum' to the end of the ethmoid wing passes well above the upper surface of the skull.

Changes in the suspensory apparatus.—Considering the suspensory apparatus and the palato-quadrate elements as a whole, we see that in the early stages of sexual development the lower angle of the frame-work, i.e. the lower end of the quadrate bone, where it articulates with the lower jaw, is directed forward. In the fourth stage of sexual development the same angle of the frame-work is noticeably moved backward.

A question arises: how at this stage can the free ends of the lower and upper jaws coincide, when the fore end of the upper is lengthened forward with the growth of the 'rostrum', and the lower jaw is moved backward?

A quantitative study of the changes shows that this equilibrium is attained by means of the extremely high rate of growth of the lower jaw. With the breeding changes the lower jaw becomes relatively more lengthened than the 'rostrum'.

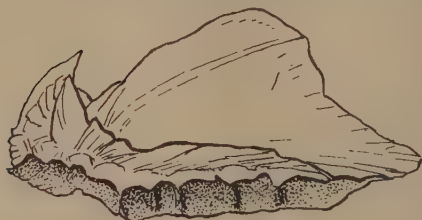
Changes in the jaws and in the teeth.—The jaws undergo striking breeding changes, but here only the changes in the premaxillary bone will be dealt with.

When the fish is on its marine feeding grounds, the premaxillary bone is short and broad at its hinder end; the teeth are long and narrow at their bases, and are well fastened to the bone. Each tooth is followed by a successor, which is immature and not fastened to the bone, though the soft parts of the successory teeth are set in their sockets (fig. 1, a). I term the teeth present in the salmon in the first stage of sexual development the 'feeding teeth'. In the salmon



1 5 10 15 20 mm.

(a) First stage. (The successory teeth not fastened to the bone are not shown.)



10 20 30 mm.

(b) Second stage. (The immature teeth lying under the bone and not fastened to it are not shown.)



10 20 30 40 50 60 70 mm

(c) Fourth stage.

FIG. 1.—The right premaxillary of *Salmo salar* male in different stages of sexual development (seen from inside).

moving to the shores for spawning purposes the premaxillary bone is relatively longer, and its most typical feature is that there are no teeth fastened to the bone. The tooth sockets are present, but not so clear as during the first stage (fig. 1, *b*). New teeth start to develop at the second stage. I term these teeth the *breeding teeth*. The breeding teeth in the second stage are small hard cones lying in a layer of connective tissue under the mucous membrane of the mouth. The teeth do not protrude and are lying horizontally with their tips directed into the mouth. The mucous membrane is pierced by oblique slits present over each tooth. If we press from both sides of such a slit, the tooth cone easily falls out through the slit.

During the third stage, at the time when the fish is ripening in the river, the premaxillary gradually lengthens and grows in depth at its fore part. The breeding teeth protrude and become partially fastened to the bone.

By the breeding, or fourth, stage the positive phase of the breeding changes is accomplished, and the premaxillary has doubled its length. The fore ends of the premaxillaries, growing faster than other parts of these bones, project now far beyond the anterior end of the '*rostrum*' and a large hollow has formed between these ends. The function of this hollow is to receive the hook growing on the anterior ends of the dentals. All teeth are securely fastened to the bone. The breeding teeth are relatively short, broad at their base, and curved. After maceration they can be separated from the bone and the tooth sockets are seen (fig. 1, *c*).

During the fifth stage the premaxillary diminishes in size and resumes its former proportions and size. The breeding teeth, having no room on the shortened surface of the bone, fall out.

Similar changes occur in other tooth-bearing bones. In breeding males the dentals become strongly curved, their fore ends growing upward; and between these fore ends a large hook consisting of connective tissue is developed.

Though here not discussing the breeding changes in other parts of the skull, I should like to note one particular case which I think of some theoretical interest, i.e. the changes in the glosso-hyal teeth. Well-developed *feeding* glosso-hyal teeth are present in the salmon during its first stage when the fish is on its marine feeding grounds. These teeth disappear at the second stage when the fish moves to the sea-shores, and new *breeding* glosso-hyal teeth grow on the pharyngeal plates when the fish reach their spawning grounds. These breeding glosso-hyal teeth are not used by the fish in the ordinary way, for the fish does not feed at this time at all; they obviously cannot be used for defence, fighting, &c.,

for their position makes such a use clearly impossible; they cannot attract the attention of individuals of the opposite sex, for the pharyngeal teeth cannot be seen without dissection.

THE SECOND OR *ONCORHYNCHUS* TYPE OF BREEDING CHANGES.

Species belonging to the genus *Oncorhynchus* (*O. keta*, *gorbuscha*, *tschawytscha*, *masu*, *nerka*, and *kisutch*), in spite of their great superficial likeness to *Salmo*, have a different type of skull.

Studying the breeding changes of these groups it is especially essential to note the difference in the structure of the fore end of the 'rostrum', of the premaxillary bones, and of the dentals.

The 'rostrum' of *Salmo* is forked and ended with paired labial cartilages; in *Oncorhynchus* the 'rostrum' and the labial cartilage are azygous.

These peculiarities (as well as some others) in somatic features have a determinate influence on the characters developing with sexual maturity.

In breeding specimens of *Oncorhynchus* the lengthening of the 'rostrum' and of the whole upper jaw is greater than that of the lower, and therefore in breeding males the upper jaw noticeably projects beyond the lower. But in breeding *Salmo* the fore ends of the jaws coincide. The facial part of the chondrocranium becomes curved, and the skull acquires a saddle-shaped form in both genera.

In breeding specimens of *Oncorhynchus* the lower end of the suspensory and palato-quadrate frame-work is moved backward as in *Salmo*, and several elements of this apparatus are essentially lengthened.

Striking changes develop in the jaws. In *Oncorhynchus* reaching the sea-shores the premaxillaries are small boat-shaped bones bearing no fastened teeth, and having no tooth sockets. The premaxillaries do not reach either the fore end of the 'rostrum' or the fore end of the maxillaries. In this stage the premaxillaries are underlined by a thick layer of connective tissue with immature teeth embedded in it. These teeth do not protrude through the mucous membrane, but lie horizontally with their tips directed into the mouth like the teeth of *Salmo* in the second stage of sexual development (fig. 2, a). The essential difference between *Salmo* and *Oncorhynchus* is that in *Oncorhynchus* the layer of connective tissue with the immature teeth lies not only under the premaxillary itself, but extends beyond it in both directions, reaching the end of the 'rostrum' in front and the maxillary behind.

During the breeding metamorphosis there develops above each tooth a new ossification, which fuses with its tooth and forms a kind of 'tooth-root'. All these 'tooth-roots'



a.

(a) The right premaxillary of a male entering fresh water. (The immature teeth lying under the bone and not fastened to it are not shown.)



b.

(b) The right premaxillary of a breeding male. Approximately natural size.



(c) The same specimen. The left premaxillary after maceration. (Slightly reduced.)

FIG. 2.—The premaxillary of *Oncorhynchus keta* (seen from outside). (Diagrammatic.)

grow together from the sides forming an unbroken row, which also anchyloses with the premaxillary where that bone covers it. In this way is formed the new 'breeding premaxillary',

c

which in males becomes an enormous curved bone armed with strong curved teeth (fig. 2, *b*); if macerated it falls into its compounds, the true premaxillary itself, and the separate ossifications armed with their teeth (fig. 2, *c*).

The anterior pair of these ossifications overlap the fore end of the 'rostrum', but in *Oncorhynchus* there are no free fore ends of the premaxillaries projecting beyond the 'rostrum' to form a hollow between them, as we have seen in *Salmo*.

Teeth similar to those just described develop on all tooth-bearing bones, but the ossifications above the teeth are smaller except in the case of the fore ends of the dentaries and of the maxillaries. In the case of some of these tooth-bearing bones the ossifications above the teeth grow together as a narrow plate which fuses with the adjacent bone.

Very strong teeth and 'tooth-roots' grow over the fore end of the dentals. In *Oncorhynchus* in the 'clean' state, the fore ends of the dentals are flattened and form, as it were, small platforms. In breeding specimens these platforms are greatly enlarged and the 'roots' of the breeding teeth are fastened to them. The 'tooth-roots' grow together with the dentals and determine the curved shape of the dentals in the breeding males of *Oncorhynchus*. Thus the knob on the ends of the dentals of breeding *Oncorhynchus* is of quite different structure from that of the breeding *Salmo*.

In concluding this brief account of the breeding changes in the skulls of *Salmo* and *Oncorhynchus* I should like to emphasize the fact that the peculiarities of both described types of breeding changes (*Salmo* and *Oncorhynchus* types) undoubtedly depend upon somatic peculiarities in the structure of the skulls of *Salmo* and *Oncorhynchus*. Moreover, several of the breeding characters determining the very type of the breeding changes are already present as somatic characters in skulls not yet affected by the breeding changes, but at times other than those of sexual activity they are in an immature state as rudimentary or vestigial structures.

The PRESIDENT said it would be interesting to hear whether or no the breeding changes were the same in both sexes.

Dr. G. P. BIDDER asked whether the 'hook' of the lower jaw was used for digging the 'nest'.

Mr. R. H. BURNE drew attention to the fact that in the Salmon the mucous membrane of the alimentary tract underwent degeneration during the breeding period.

In reply Dr. TCHERNAVIN said that the breeding changes in the females are in their main features analogous to those of the males, but developed in much smaller degree. In rare cases large females of *Salmo salar* develop a 'hook' on the end of the lower jaw.

He did not think that the males use the 'hook' on the ends of the lower jaw for digging; he thought that the 'nest' is prepared by the female with the movements of her tail. By similar movements the female covers the eggs with gravel after fertilization.

Steppe and desert in the light of lichen vegetation. By Dr. ISRAEL REICHERT, P. J. A. Agricultural Experiment Station, Rehoboth, Palestine.

STEPPE and desert have served as a favourite subject of study since the very beginning of plant-geographical investigation. In spite of this no clear understanding yet exists concerning the definition of these two plant regions. Thus the word 'steppe' is still used by authors in various ways. So for instance Groebal in his new edition of Warming (13) calls all the open dry plant formations covered either with grasses (like *Stipa* etc.) or herbaceous plants (*Artemisia* etc.) steppes, whereas Rübel, in his book on plant-communities of the world, published in 1930, places the grass steppes under *Duriherbosa* which means 'hard meadows', whereas *Artemisia* steppes he puts under *Deserta*.

The plant-geographical position of the various steppes is equally obscure. Engler's Syllabus (3) takes the view that the steppes of Western Asia belong to the Mediterranean plant region, whereas the steppes of Southern Russia are added as a special pontic plant province to the middle European region. Griesebach (4) and most recent plant geographers combine steppes of Western Asia and those of Southern Russia in one plant region (1).

The same lack of distinction exists regarding the plant-geographical position of the desert. Engler (3) attaches the desert of Sahara to the palaeotropical region, whereas Griesebach (4) considers this desert as a continuation of the desert near Baluchistan in India which crosses North Arabia, the Sinai peninsula, south to Palestine and North Africa.

In order to get more clearness on these problems I tried to approach them from a new angle. Up to now phanerogamic plants have mainly been used as comparative plant-geographical *indicators*. For the first time I tried to use lichens for the floristic characterization of a whole region (7).

This investigation is based on observations in the steppes and deserts of Palestine and Egypt and on a taxonomic study of the lichens found in these regions.

Palestine and its adjoining countries is considered as the most appropriate for the study of these problems, as in this corner the three continents approach each other most closely.

The questions considered during this study were:—

1. Can lichen vegetation give us any help in defining the characteristics of plant formations in steppe and desert?

2. Can lichen vegetation throw any light on the question of plant-geographical relations of steppes and deserts in various regions ?

3. Do plant-geographical relations that may be established by the help of *lichens* correspond to those established by phanerogamic plants ?

Plantgeographical definition of steppe and desert.

Steppe is physiognomically characterised by the absence of trees and by a more open plant cover ; climatically by a low amount of rain, long periods of drought, and by cold winters ; floristically this plant region may be characterised by various grasses, e.g. *Stipa*, *Poa*, and various herbaceous plants like *Artemisia* etc. (1).

The steppes of South Russia and Western Asia are characterised by all these features. Eig, the Palestine botanist, names, therefore, this region of steppe the *Irano-turanic region* (1). In Palestine steppe formation is typically represented in Transjordan, in an enclave in the south of Palestine called the 'Negel', and on a section of the eastern part of the Mountains of Judaea. In Egypt I have not so far found any steppe formation, although I assume its existence.

Desert physiognomically appears much more open than the steppe. The plant cover is much sparser, the greater part of the soil being uncovered.

Climatically it is characterised by the very low amount of rain, high drought, and temperature, and, what is especially important, warm winters ; floristically by absence of grasses and the predominance of *Chenopodiaceae* and more or less succulent plants. Eig names the deserts of North Africa, South Palestine, North Arabia, and Sind, in accordance with Griesebach, the *Saharo-sindic region* (1). In Palestine the Jordan valley and the Negheb (the South of Palestine) belong to this region (1). The greatest part of Egypt seems to be a desert land and belongs therefore to this region.

Lichen vegetation of the steppe.

Steppe is the only plant region which has been adequately investigated, Russian botanists having mainly contributed to this knowledge. Elenkin (2) was the first to describe characteristic lichens of the steppe. He dealt with the wandering lichens of the steppe, i.e. lichens which become detached from their substrate and are dispersed by wind. Most of these lichens belong to the group of *Aspicilia esculenta*. The second important study of steppe lichens was made by Tomin and Boris Keller (6), who gave detailed lists of lichens of the steppe and so-called half deserts in Turkish Russia. As the most characteristic lichens of these steppes, these authors cite *Aspicilia esculenta*. This covers great spaces

of the soil. Another not less important lichen, *Diploschistes scruposus* var. *terrestris*, is widespread on the soil of these Russian steppes and half-deserts and may be especially emphasized.

Aspicilia esculenta has its chief distribution in Asia Minor, Persia, and Mesopotamia—in other words, it is characteristic of the irano-turanic region.

Aspicilia esculenta has also been found in the steppes of Algeria. This fact may indicate that the steppes of this region are related to those of South Russia and of Western Asia.

On the other hand, I have not found *Aspicilia esculenta* in the steppes of Palestine and Transjordan, nor was it found by Handel-Mazetti in Mesopotamia (II). This shows that the steppes of Mesopotamia and Palestine are totally different from those in Southern Russia, Asia Minor, and perhaps also in Algeria.

The characteristic lichen of the steppes in Southern Russia, *Diploschistes scruposus* v. *terrestris*, does not occur either in Mesopotamia or in Palestine. In both these regions another *Diploschistes* species—*Diploschistes steppica* occurs (8). This lichen is dominant in both regions; it covers enormous spaces of the soil and especially it creeps and grows in the stubs of *Poa bulbosa* var. *vivipara*. This lichen renders the plant-geographical position of Palestine and Mesopotamia quite different from that of the Russian steppes. It may be added that *Diploschistes steppica* has been shown to occur as far as Western Persia in the east and Naku in the north. The occurrence of this lichen in North Africa is not yet verified.

Lichen vegetation of the desert.

The lichen vegetation of the desert has scarcely been investigated. Elenkin deals with some of the lichens in his above-mentioned paper. Most of the desert lichens were casually collected by various botanical collectors. Their plant-geographical nature has never been dealt with.

Lichens may be found in the desert not only in places where some flowering plants still grow, but in places where no flowering plants exist. The bare soil of the desert, when firm and not drifting, is mostly covered by lichens. This fact may be especially emphasized, as these places have always been overlooked by all collecting botanists. Rohlfs, Volkens, and Hooker (12), who studied these deserts, state that they crossed hundreds of miles without finding flowering plants. Hooker says in this connection that the botanist has lost his sight in these regions. My investigation of the desert in Palestine and Egypt has shown what a great task awaits the botanist in these so-called waste regions.

I found on the desert soil *Buellia subalbula* Müll. Arg.; *Dermatocarpon hepaticum* f. *nigratum*, and various characteristic *Lecanora*, *Heppia*, and *Psorotichia* species. On flint stone we have found as characteristic *Caloplaca Ehrenbergii* Nyl. and *Ramalina maciformis* Nyl.

Diploschistes as a distinctive indicator of steppe and desert.

My investigation on the lichen vegetation of the steppe and desert in Palestine and Egypt brought out a very interesting fact: *Diploschistes* occurs only in the steppe region, to which it is always restricted—i.e. where *Poa bulbosa* var. *vivipara*, a typical component of the irano-turanic steppe, is growing.

Immediately the irano-phanerogamic flora ceases and gives place to the desert flora or saharo-sindic flora, *Diploschistes* disappears also. Sometimes *Diploschistes* penetrates into the desert—as in the northern part of the Dschebl Mantour, in the desert of Juda. But this special case is explained by the particular local water conditions, a natural well being present here.

Diploschistes may therefore be considered as even more sensitive to edaphic and climatical steppe conditions than phanerogams.

In the conditions of modern Palestine where waste land and deserts are being turned into arable land, this lichen may render a service to agriculture and colonisation.

It may be emphasised that according to my investigations on terrestrial *Diploschistes* lichens in various parts of the world, they are invariably confined to steppe soil and never grow in deserts. This fact shows that these lichens may also serve as indicators of arable soil in other countries.

Summary.

1. Bare places of the desert bear a rich cover of lower plants, i.e. of lichens.
2. Lichens may be of great use in defining the floristic characteristic of steppe and desert.
3. With the help of lichens it is possible to prove the identity of the desert in Egypt and in Southern Palestine.
4. A similarity of the desert in Algeria to those in Egypt and Palestine was established.
5. With the help of lichens the different nature of the steppe in Southern Russia from that in Palestine and Mesopotamia was proved.
6. Lichens may decide whether certain plant formations in arid regions have to be regarded as desert or steppe.
7. Terrestrial *Diploschistes* species were found to possess an economic value by indicating the steppe or arable nature of the soil upon which they grow.

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Mr. I. MACKENZIE LAMB said that, having recently been engaged in the study of a collection of lichens from the Persian region, he had followed Dr. Reichert's remarks with very great interest. Dr. Reichert had had the great advantage of studying the ecological relationships of his plants in the field; and his revelations of the value of lichens as indicators of the floristic characters of the regions known as a steppe and desert show how desirable it is that collectors of exotic lichens, particularly those not trained as botanists, should pay particular attention to the ecological relationships of the plants which they collect, so that the specialist to whom they are sent for determination may gain some idea of the edaphic and climatic factors influencing their distribution. He would like to add his appreciation of Dr. Reichert's most interesting and instructive lecture.

Mr. S. GARSIDE said that he was interested to find that many of the genera (*Diploschistes*, *Dermatocarpon*, *Caloplaca*) and even some of the species (*Psora decipiens*) observed by Dr. Reichert were the same as those to be found in similar habitats in South Africa. It was evident that many of the genera characteristic of desert and steppe are widely distributed, and therefore cannot be used to delimit plant geographical areas in the way that phanerogamic plants are used.

The following papers were read in title :—

‘Scientific results of the Cambridge Expedition to the East African Lakes, 1930–1.—No. 17. The vertical distribution and movements of the plankton in Lakes Rudolf, Naivasha, Edward, and Bunyoni.’ By Dr. E. B. WORTHINGTON, F.L.S., and C. K. RICARDO, B.A., F.L.S.

‘Contributions to the study of some African mammals.—I. The humerus and femur of certain East African antelopes.’ By A. TINDELL HOPWOOD, D.Sc., F.L.S.

‘Extinct Pleistocene mollusca from Lake Edward, Uganda, and their bearing on the Tanganyika problem.’ By V. E. FUCHS, M.A. (Communicated by Dr. E. B. WORTHINGTON, F.L.S.)

‘Additions to the Trombidiid and Erythraeid Acarine Fauna of Australia and New Zealand.’ By H. WOMERSLEY, A.L.S., F.R.E.S.

‘The seasons in a tropical rain-forest (New Hebrides).—Part 3. Fruit-bats (Pteropidae).’ By JOHN R. BAKER, M.A., D.Phil., and ZITA BAKER. (Communicated by Professor E. S. GOODRICH, F.R.S.)

‘The seasons in a tropical rain-forest (New Hebrides).—Part 4. Insectivorous bats (Vespertilionidae and Rhinolophidae).’ By JOHN R. BAKER, M.A., D.Phil., and T. F. BIRD, B.A. (Communicated by Dr. JULIAN S. HUXLEY.)

‘Études sur la biogéographie intercotidale des deux rives de la manche.’ Par E. FISCHER-PIETTE, Dr.Sc. (Communicated by Dr. E. J. ALLEN, C.B.E., F.R.S., F.L.S.)

The PRESIDENT announced that Mr. M. A. C. HINTON, F.R.S., had been unanimously elected as Zoological Secretary for the present Session.

Dr. G. P. BIDDER proposed a vote of thanks to Dr. STANLEY KEMP, F.R.S., for the great services he rendered the Society during his tenure of the Zoological Secretaryship. Dr. Kemp expressed his thanks.

12 NOVEMBER 1936

Dr. W. T. CALMAN, C.B., F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 29 October 1936, having been circulated, were taken as read and confirmed.

The President reported the deaths of Daniel Angell Jones, A.L.S., and Marius Maxwell, F.L.S.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellow signed the Obligation in the Book of the Charter and Bye-Laws and was admitted :—Thomas Ashton Lofthouse.

Certificates of recommendation of the following candidates for Fellowship were read :—For the second time, in favour of Henry Alexander Lindeman, Menie Watt, Lionel Hugh Knightley Finch, Ralph Ellis, Frederick William Andrews, Amos Perry, Terence Charles Stuart Morrison-Scott, Sir John Reeves Ellerman, Bart., Andrew William Ernest Soysa, and Brian Seymour Vesey-FitzGerald.

Professor G. D. HALE CARPENTER, M.B.E., F.L.S., exhibited and read (1) An unpublished letter from Sir Joseph Hooker, dated 9 Aug. 1847; (2) An autograph note by Linnaeus on a prescription, written for him, dated 31 Jan. 1764. The President made some comments.

COPY OF LETTER FROM JOSEPH D. HOOKER
TO W. B. CARPENTER.

Kew, August 9, 1847.

My dear Sir,

During the time I was out with Sir James Ross I paid some attention to the subject of employing ardent spirits, both as an occasional stimulant & as a daily beverage in the form of grog: & I further asked the opinion of many officers long connected with the service.

In all ordinary cases, where dependable men are employed, it may be entirely dispensed with; but I am not so clear about the propriety of abolishing it at once, in the present state of the service, or at all under peculiar circumstances.

Several of the men on board our ship, & amongst them some of the best, never touched grog during one or more of the antarctic cruises; they were not one whit the worse for their abstinence; they enjoyed the same perfect health that all the crew did, throughout the 4 years voyage.

That these & many others of the men would have preferred a pint of hot coffee on occasions of "splicing the main brace" I am quite sure, but when the circumstances called for (in the eyes of the service) the stimulus, there was no cooking, nor could there be. I had better however, answer your questions to the best of my knowledge seriatim.

1. May the habitual use of fermented liquor be safely dispensed with? I should say clearly so & with benefit too: *provided the water be good*. For the comfort of the men too the water should be palatable, & this is far from universally practicable. The officer can vary his viands and drink, so much that to have no spirits is no loss to him: but there is no substitute for grog to the sailor. Beer is too bulky.

Lemonade soon palls when daily used, & would not agree with all; cold tea is not palatable to every one, even if recommendable; and he gets hot tea once a day as it is, which in hot weather is almost once too often. You must not judge the Royal Navy by the Merchant Service where the sailor joins for immediate profit & is willing to go through the voyage with bad water and no spirits, for it only lasts a few months or years; in joining an abstinence ship he does not forswear grog for ever, & has opportunities of varying his beverage with his ship.

The good Navy sailor again, ships for 40 years, at least such are the men we want to prize, & for five or even seven years commission at a stretch, in a very hot climate, where the water is bad perhaps, he has but one diet and no prospect of its being altered. Perhaps the gravest objection to abolishing fermented liquors in the Navy allowance is, that you cannot do so with the officers: they are allowed to buy & lay in private & mess stock & the service allows them stowage; it is not so with the sailor; he is prohibited from laying in a sea-stock, both because no room is allowed him to store it, & because he could not afford it, or be trusted if he could afford.

In the Army where there is little communication between officers & men & no intimacy, this would not tell so heavily as on board-ship, where every one has a great fellow-feeling with his ship-mates and where partiality in the treatment of any class, with regard to the withholding of *what each in his station is accustomed to on shore*, could not fail to produce a very strong feeling. There are however sundry considerations.

Allowing the water to be palatable; I have no hesitation in saying that the habitual use of spirit may be beneficially dispensed with as far as the health of the crew is concerned.

2. Whether the abstinence in cold climates, is attended with positive benefit. I do think that the use of spirit in cold weather is prejudicial. I speak from my own experience: it is very pleasant, the glass of grog, warms the mouth the throat & the abdomen, & this when wet & cold with no fire & just before turning into damp blankets is very enticing; but it never did me one atom of good: the extremities are not warmed by it and when a continuance of exertion or endurance is called for, the spirit does harm: then you are colder or more fatigued $\frac{1}{2}$ or $\frac{1}{4}$ hour after it, than you would have been without it. Many of our men laid in large stocks of coffee & when practicable had it made for them after the watch on deck; these men I believe would willingly have given up their spirits in exchange for coffee: but we could not ensure them the latter on the requisite occasions.

To the southward of the Ant. circle, or of Lat. 50' you may say, it blew a gale of wind 3 days out of 5, there was always a heavy swell running, the whole ship & bedding were damp, from condensation, where not from shipping seas; the atmosphere of the lower deck (with hatches battened down) such that you could not see from one mess table to another, & this for days together. There is neither standing, sitting or lying in comfort. All hands, officers & men up & ready, the one watch on deck the 2 others on the "qui vive" for any emergency.

In cruising among the ice it must be so, in the thick weather the ship is on a Berg or Pack before one can see it almost; & is several hundred miles from open ocean, even if she could turn tail & go back.

She is perhaps put about every $\frac{1}{2}$ hour, and we have been for 16 hours in this state. Every time we go on deck we are drenched with cold salt water, which sometimes freezes as it falls, & when you go below there is really nothing to do but "lick your paws" as the men say. Nothing hot can be got. This is perhaps as extreme an instance as I could bring forward of the demand for spirits under yr. third query. Now I do not believe that to "splice the main brace" $\frac{1}{2}$ dozen times or even more in this 16 hours would do any good in the way of giving strength; but to refuse the men some grog would be a great hardship. I have seen grog given ($\frac{1}{2}$ gill at a time) thrice (I think) under such circumstances, with no perceptible harm; but I do not suppose it did any good, & more would I am sure have [? done] me mischief.

The fact of giving it did good in one way, it made the men joyful (not from excitement but as we all rejoice on cutting the Xmas pudding) & I quite believe that under such continued exertion the bad effects were dissipated; but this is a very different thing from doing any real physical good; I can well suppose the effect to have been, though inappreciably, the contrary. Of one thing I am sure, & that is, that no one was ["I was not", crossed out and replaced by "no one was"] the more ready for a repetition of the exertion from taking the stimulus:—the intervening time was more pleasantly & comfortably passed.

It may here be a question whether, granting the spirits to have done some good towards exhilarating; when no modern appliances could be available; it would be desirable to withdraw it on such occasions, it is a choice of evils perhaps.

I know of only one occasion on which the spirit appeared indispensable—that is when a little more exertion at the arousing of a mighty & long continued effort is demanded.

Thus—the ships when sailing in the Pack-Ice are sometimes beset, or fall to leeward into the lee-ice, this takes 2 or 3 minutes, but if there is much wind it takes many hours to get them out, not being in command the sails are no use, & the ice prevents her moving in any way but with it to lee-ward. Under these circumstances: the only way to get her out is by fastening ropes from the ship to the large masses of ice & warping her out by main force against the wind. Now I have seen every officer and man in the ship straining at the capstan for hours together, through snow & sleet, with the perspiration running down our faces & bodies like water. Towards the end of such a struggle, at the mighty crowning effort, I have seen a little grog work wonders, I could not have drunk hot coffee without stopping to cool; nor if I had do I think it would have supplied the temporary amount of strength, which was called for *on the spot* under circumstances like this. These are however cases which do not affect the sailor in his ordinary condition, & which any ship might be well prepared for.

The great practical difficulty on board ship is, that you have no available substitute for bad-water but good grog, as the sailor is at present situated.

I cannot but think however that with more attention to the comforts of the sailor, his own love of liquor wd diminish ; and that he might be weaned from it by the officers ; though the depriving him of it by the Govt would be a dangerous experiment.

I fear you will find this a very unsatisfactory answer : I wish it were otherwise but I often tried to cut the Gordian knot in my own mind. It is a good deal like that most repulsive of all punishments, flogging in the Navy ; for which no one can propose an immediate substitute.

If I can be of any use to you pray command me : I can hardly think this will be satisfactory. I can only honestly declare myself free from prejudice.

ever sincerely yours

(signed) JOS. D. HOOKER.

Passages from this letter were quoted in W. B. Carpenter's Prize Essay 'On the use and abuse of alcoholic liquors in health and disease' published in 1850 in London by Charles Gilpin.

Polyploidy in the genus *Tulipa*. By Sir DANIEL HALL, K.C.B., F.R.S. (Communicated by Professor F. E. WEISS, F.R.S., F.L.S.) [Abstract.]

SIR DANIEL HALL gave a *résumé* of the work that had been done at the John Innes Horticultural Institution in continuation of the paper by W. C. F. Newton, who described before the Linnean Society in 1927 his discovery of polyploidy among the species of *Tulipa*. Since that time the examination has been extended to some seventy to eighty species, now growing at the Institution. Though this is less than one-third of the species enumerated in the 'Index Kewensis', synonyms are so numerous that the genus has been pretty well covered, except for certain Central Asiatic species that have never been in cultivation. The *Eriostemon*es group, with twenty species, includes one triploid and four tetraploids ; in the *Clusiana* group there are three tetraploids and one pentaploid, and two hitherto undescribed diploids, which may be the origin of these tetraploids, have been found in material from the Himalayas. The '*oculus-solis*' group includes at least four triploids, and the two members of the somewhat anomalous group from China and Japan are tetraploid. Throughout the genus the basic number of the chromosomes is twelve : fragments occur in two species, but aneuploids have been obtained only by experimental crossing. Cytological examination has been of service in determining the taxonomy of the genus, both in discriminating between diploids and polyploids which resemble one another so closely that they have often been confused, and in adding other evidence towards the determination of a 'good' species. Otherwise cytological examination has gone to confirm conclusions based upon general morphological considerations.

Professor F. E. WEISS expressed his interest in Sir Daniel Hall's communication. He considered it very valuable that the nuclear constitution of the various species of a genus should be ascertained. Where apparently identical forms differed only in the number of their chromosomes he did not consider that they should be classed as distinct species but as special races of the same species on the analogy of biological races or strains of fungi.

Professor R. R. GATES said that Sir Daniel Hall was to be congratulated on having brought together such a large collection of Tulip species for study. The subject of polyploidy had grown amazingly since the first case was investigated in 1909. It was exceptional to find a genus of flowering plants (such as *Carex*) in which it did not clearly occur. Nevertheless, the phenotypic differences resulting from polyploidy varied so much from genus to genus that it was very doubtful whether any rules for the taxonomic nomenclature of triploids, tetraploids, and higher polyploids could be laid down which would be of general application. In some cases the differences were great enough to be clearly specific, in others they might be varietal or even non-existent. He asked Sir Daniel Hall whether there was any general relationship between diploid, triploid, and tetraploid tulips as regards their relative areas of distribution.

Dr. A. B. RENDLE said that the chromosome number should not be regarded as a determining factor in the discrimination of species. It was merely one character which should be considered in conjunction with others for purpose of nomenclature.

Mr. H. N. DIXON suggested that as the Blood Groups in the human race constituted differences of vital importance, and yet would not be held to be specific characters, so the factors of polyploidy, while important or even fundamental, need not be considered to constitute specific differences.

The PRESIDENT also spoke; and Sir DANIEL HALL replied to questions.

On a few Indo-Pacific species of *Pinnotheres*, with special reference to asymmetry of the walking legs. By Dr. ISABELLA GORDON, F.L.S. [Abstract.]

ALTHOUGH the fact that a small crab is frequently found living within the shells of bivalve molluscs, such as oysters, mussels, and *Pinna*, was well known to ancient writers, little is known even now concerning the habits of these crabs. There is, however, no reason to believe, as did Aristotle, Pliny, Linnaeus, and others, that the mollusc benefits in any way from the presence of the crabs.

The genus *Pinnotheres* is large, comprising over a hundred species, many of which are known only from one or two female specimens; the male, which does not live within molluscan or other hosts, is known only in a few species. Apart from slight differences in shape of carapace and of the third maxillipeds, the characters distinguishing the females are found in the walking legs. For example, in many species the dactyli (or claws) of the four walking legs are similar in shape and subequal; in many others the dactyli of the two posterior pairs differ in shape and size from those of the two anterior pairs. In the latter group I found, in 14 females examined, a marked asymmetry of the third or longest pair of legs. The leg on one side of the body is shorter than on the other, and this difference is most marked in the dactylus, which tends to approach that of the second leg in shape as well as in size; the propodus is also rather shorter. If the shorter limb is used in determining the specimens by means of Tesch's key, they run down to one group of species, if the longer limb, to another group. De Man is the only previous worker who observed this asymmetry and he at first regarded it as 'une anomalie', but later suggested that it might prove to be a constant character of certain species. With this latter view I agree. I examined some other material in the British Museum collection and found this asymmetry in some but not in all species. The most striking example of asymmetry is exhibited by a female from New Zealand (species not determined, probably new), in which the *three anterior pairs* of legs are shorter on the right than on the left side.

This asymmetry will have to be studied in considerable detail by anyone who may attempt a revision of the genus. It would be interesting to study it carefully in one common species in order to determine whether it is characteristic of both sexes, or only of the female. If it should prove to be restricted to the female, it might be that, owing to the position taken up within the host, the growth of the longer leg (or legs) on one side of the body is rather hampered.

Mr. W. S. ROWNTREE asked whether the Crab's asymmetry of legs on the two sides could have any connection with its mode of progression: in the sense that, if it were the creature's habit to move sideways more readily to one side than the other, that might have produced such asymmetry.

The PRESIDENT, referring to Dr. Gordon's mention of the reported use of *Pinnotheres* in Egyptian hieroglyphics to symbolize the dependence of a man on his friends, stated that this rested on authority of Horapollon, an Egyptian who wrote in Greek in the 4th century A.D. Enquiry among Egyptologists, however, had failed to obtain any confirmation

of Horapollo's statement, the symbol in question being unknown to them.

Replying to Mr. Rowntree's question, the President stated that little was known about the habits of these crabs, but that, once she had entered the mollusc, the movements of the female were probably very limited.

Scientific results of the Cambridge Expedition to the East African Lakes, 1930-1.—No. 16. The smaller Crustacea.

By A. G. LOWNDES, M.A., F.L.S. [Abstract.]

THE total number of species was thirty-eight, and this number was made up as follows :—Cladocera sixteen species, none of which is peculiar to East or Central Africa, while eight of the species are well known within the British Isles. Copepoda nine species, consisting of five species of Calanoida and four Cyclopida. The Calanoida are all confined to East or Central Africa, while of the four species of *Cyclops* three are well known within the British Isles, while one (*Cyclops gibsoni* Brady) is African, though its range extends to South Africa. Ostracoda thirteen species, one of which only, *Cypridopsis newtoni* Brady & Robertson, has been recorded so far outside Africa. Altogether five new species were recorded, consisting of one Calanoid and four Ostracods. These figures are of some interest, for they illustrate what is already known about the freshwater Entomostraca in general. The Cladocera, in which parthenogenesis is quite common and resting eggs abundant, possess numerous genera and species which are practically cosmopolitan.

In the Copepoda, where parthenogenesis is unknown, the Calanoida possess resting eggs and are easily obtained from dried mud, and yet there is no single species of Calanoid that can be described as cosmopolitan. *Cyclops*, on the other hand, does not produce resting eggs and it is exceptionally rare to obtain specimens from dried mud, and yet the majority of the major species are cosmopolitan. Among the Ostracods parthenogenesis appears to be the rule rather than the exception. Whole genera are known in which the males have never been recorded, while recent research has practically established the fact that even when the males do occur syngamy does not take place, a nucleus being absent from the sperm. It would thus appear that there is every reason to expect a wide distribution of the species, and yet they are remarkably restricted. Thus in a collection such as the present one we should expect to find many European species of Cladocera and *Cyclops* accompanied by new species of Calanoids, chiefly *Diaptomus*, and many new species of Ostracods. This statement is confirmed by the enormous

increase within recent years in the number of species of *Diaptomus*, but I am afraid that taxonomists working on Ostracods are few in number. Before leaving this point I would quote a statement of Gurney 1933. 'It seems broadly speaking that there are relatively few major species of *Cyclops*, most of which are found in Europe, and that round each can be gathered satellites, which one can designate as species only at the peril of losing grasp of reality.'

Apart from the number and distribution of the species in general there are, however, several points which should be of general interest. The first deals with an altogether distinct species of a calanoid copepod, *Paradiaptomus africanus* Daday. Apart from the general specific and generic distinctions the species is exceptional in that each of the abdominal segments of the male and female bears some fairly conspicuous spines. In 1930 I recorded this as a new species, taking it from a very alkaline Crater Lake in Abyssinia where it was almost the only entomostracan present. Kiefer pointed out, however, that it was probably a species recorded by Daday in 1910 from Lake Nyassa, and I am convinced that Kiefer is correct. The species occurred in the present collection, being taken from a highly alkaline Crater Lake near Lake Naivasha, where it was again the only entomostracan present. Daday records it, however, from Lake Nyassa and other lakes, where it not only occurred in perfectly fresh water, but in association with many well-known European species of Entomostraca and other invertebrate animals. Thus we have a very distinct and indigenous species equally at home in highly alkaline or in fresh water. It may also be almost the sole Entomostracan occupant or it may live in a highly cosmopolitan association.

L. C. Beadle has spent much time and labour on the chemical composition of these lakes, and also made many determinations of the hydrogen ion concentration. I would point out, however, that it is not necessary to go to East Africa to look for problems of this kind. In this country there is a species of *Cyclops*—*Cyclops langvidus* Sars (almost as aberrant as *Paradiaptomus africanus*), which is the sole Entomostracan occupant of a swamp at Alderbury Common, Hants. It occurs in a large stretch of water having a pH as low as 2.5, which is the lowest ever recorded for any natural water, while the species is equally well at home at Cothill near Oxford, where it occurs in water with a pH of 7.8 associated with all the rank and file of any inland pond. The species also occurs abundantly at Wicken Fen. Still nearer home, if possible, there occurs in the River Cam at Cambridge a small ostracod, *Hemicythere villosa* Sars, recorded by Brady and Robertson, 1870. Not only is it traceable in the fossilized

state to the Glacial Clays in Scotland, Ireland, and Norway, but it extends in the living state out to sea, where it is dredged off the coast of Norway at a depth of 180 fathoms. Finally, there is on record the result of a piece of research extending over five years dealing exclusively with pH, and the distribution of forty-four species of fresh-water copepods*. The second point of general interest deals with the distribution of the well-known species *Cyclops leuckarti* Claus. This is the type-species for Sars's genus *Mesocyclops*, which now comprises just forty species.

Now it is characteristic of the genus *Cyclops* used in the broader sense, a genus comprising well over 300 species, that there is always a seta on the inner corner of the basipodite of the first swimming foot. This seta is absent only in a few species of *Microcyclops*, and it may be absent in *Cyclops prasinus* Fischer or *Leptocyclops prasinus* of Sars. It is also absent in *Cyclops leuckarti*, and this makes it possible to trace the distribution of this species with considerable certainty. The point was stressed by Sars and also by Gurney, but otherwise it has been neglected. Now *Cyclops leuckarti* seems to be the most widely distributed species of *Cyclops* known. It is recorded both from the Arctic and Antarctic regions, Europe, Asia, Australia, Japan, Tasmania, etc., but it has never been recorded from South America. Gurney has investigated the matter carefully, while during the last twelve years I have been on the look-out for the species in South America. Not only have I had the opportunity of working through Dr. Carter's collections from Paraguay, but quite recently a comprehensive survey of the fresh-waters of Brazil has been made and I have received some 600 samples to work through. *Cyclops leuckarti* is absent. This is not altogether an isolated instance, for *Cyclops prasinus*, one of the commonest species in Europe and recorded from most parts of the world, is apparently absent from Scandinavia.

The third point of general interest relates to the feeding of Entomostraca in general. In recent times it has become the custom to regard these as filter-feeders, by which it is meant that certain of the limbs set up currents in the water by which microscopic particles are brought to the animal. The particles are then filtered off and passed to the mouth. The theory was first put forward by Storch and Pfisterer in 1925 for the feeding of *Diaptomus gracilis*. The work of these authors was severely criticized by Graham Cannon in 1928, who proceeded to describe at considerable length the filter-feeding process of *Calanus finmarchicus*, giving as his conclusions that both it and *Diaptomus gracilis* feed

* Lowndes, A. G., 1928, 'Freshwater Copepoda and Hydrogen Ion Concentration', Ann. & Mag. Nat. Hist. ser. 10, vol. i, p. 457.

automatically when swimming slowly and steadily through the water. Until recently all taxonomists have looked upon the Calanoids as the most primitive group of Copepods and *Calanus* as the most primitive Calanoid. Apparently as the result of this Borradaile, in the *Invertebrata* 1935, states that in *Calanus* 'The primitive custom of feeding by the automatic straining of food particles from the water is retained'. It is not my intention to discuss the feeding of Calanoid Copepods here; suffice to it say that this non-selective and automatic feeding is founded on no kind of field evidence, and it ignores completely the work of both Lebour at Plymouth and Marshall at Millport, both of whom have investigated the feeding of copepods by making an extensive examination of their gut-contents, and I would suggest that this is the logical starting-point.

The food of Calanoids does not consist entirely of microscopic particles, while the majority of them are highly predacious, using the maxillipeds and maxillæ for seizing their food and their maxillules and mandibles for tearing it to pieces.

Gurney has recently reclassified the Calanoids and shown that the Calanidae are not the most primitive group. This place should be given to the Centropagidae with *Centropages* as the type-genus. This reclassification is of fundamental importance, for, although it was based chiefly on the form of the antennules and maxillipeds, it takes into full consideration the feeding mechanisms. *Centropages*, with its typical maxillæ and maxillipeds, is not a filter-feeder nor could it possibly feed in a way comparable to either *Calanus finmarchicus* or *Diaptomus gracilis*. It has not the necessary structure for doing so. Again, these two species are floating or drifting calanoids, and their method of feeding is in no way typical. The matter is really of considerable importance, for it is the present custom to make out elaborate food-chains on the assumption that the entomostraca feed automatically on the floating algae, and this is made the starting-point of the whole process. Probably the most important factor in the food-chain has never been investigated, and here I refer to the bottom of the pond or lake. It may be difficult to investigate this and it is usually disregarded, but it is here that one finds the small but highly predacious Harpacticids with their piercing and prehensile maxillipeds. Predacious Ostracods, such as *Herpetocypris*, *Stenocypris*, and *Candona*, preyed upon in their turn by slow-moving Isopods such as *Asellus*. Many of the Cladocera are mud-feeders, feeding on detritus. Again, it is on this bottom surface that one finds the Desmids which form such an important factor in the food-chain.

We know that no species of *Cyclops* is a filter-feeder and many of the smaller species swarm on the bottom. I would maintain, therefore, that there is a very definite bottom fauna which is highly predacious and which is constantly driving the more active forms into the more open waters. The matter does not rest here, however, for waiting to devour these there are the powerful free-swimming forms, which can be named from all the chief Entomostracan groups. Thus *Euchaeta* and *Candacia* feed almost exclusively on *Calanus finmarchicus*. *Paradiaptomus* and *Limnocalanus* apparently feed on *Diaptomus* or on any form of smaller crustacea that they can catch, or alternatively on rotifers. There are free-swimming and predacious Ostracods such as *Notodromas* and *Eucypris*, while among the Cladocera there are *Polyphemus* and *Leptodora*. Finally, I believe it is a significant fact that when one covers dried mud with water, or even observes a dried-up pond refilling after a heavy rain, the first signs of life do not occur at the top of the tank or pond but at the bottom. The mud becomes covered with a green scum, and it is here that one gets the first signs of animal life. The collection in question is devoid of Harpacticids, and I would suggest, therefore, that one of the most important links in the food-chain is missing.

Dr. E. B. WORTHINGTON expressed gratitude to Mr. Lowndes for carrying out the systematic studies, which had enabled Miss Ricardo and himself to communicate the results of quantitative and ecological studies on the plankton in a previous paper to the Society. There were, however, certain contentions in Mr. Lowndes's discourse, especially concerning the sources of food used by the small Crustacea, with which he could not entirely agree. Mr. Lowndes had suggested that the food of Crustacea in these lakes was obtained more from detritus on the bottom and from the capture of animal organisms than from minute organisms obtained by filter mechanisms. He concluded therefrom that emphasis had been wrongly placed in works describing the food-chains in these lakes. His conclusions with regard to feeding may well be true concerning shallow lakes, where there is some evidence that many species spend part of the day close to the bottom and so escape capture by plankton nets. But the Cambridge Expedition, in much of its work, had been concerned primarily with the ecology of open waters in deep lakes and the bulk of the collections submitted to Mr. Lowndes were from such environments. In many cases the quantitative data show conclusively that the small Crustacea never descend to the bottom, and therefore could not obtain their food from the detritus. These Crustacea in the open

water appear to be a fundamental link in the food-chain, and, by feeding on minute food presumably of plant rather than animal origin, they render the food-supplies of a lake available for fish. Clearly, however, there is a gradation in the methods of feeding among the Crustacea from microphagous to predacious, and each type of environment requires special investigation in the field before each species can be allocated to its correct position in the food régime.

Mr. D. J. SCOURFIELD said that the statements made by Mr. Lowndes concerning the geographical distribution of some of the smaller Crustacea were very interesting, the apparent absence from South America of such a widely distributed form as *Cyclops leuckarti* being particularly noteworthy. The great importance of the bottom, not only to the typical bottom forms, but also to many other species, although doubtful in the case of the essentially planktonic forms, was certainly correct for the inhabitants of shallow and marginal waters. Such a form as *Daphnia pulex*, for instance, normally obtaining its food by pure filter-feeding well above the bottom, could, upon occasion, be seen to go to the bottom and come up again with a large mass of detritus between its feet, such a mass often containing comparatively large elements.

The PRESIDENT commented on the interest of the problems of geographical distribution discussed by Mr. Lowndes. With regard to the differences in the methods of feeding, he thought it unlikely that the working of the filter-feeding apparatus in various Crustacea was so mechanically exact as had sometimes been supposed. Mr. Lowndes's photographs had demonstrated this lack of precision in several instances. Filter-feeding need not always be indiscriminating, although the method by which food-particles were selected for swallowing had not yet been explained, nor need it exclude the occasional ingestion of larger masses of food.

Mr. LOWNDES replied.

The following paper was read in title :—

‘Observations on the root anatomy of the genus *Aletris*.’ By H. S. HOLDEN, D.Sc., F.L.S., and L. KRAUSE.

26 NOVEMBER 1936

Dr. W. T. CALMAN, C.B., F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 12 November 1936, having been circulated, were taken as read and confirmed.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

Certificates of recommendation of the following candidates for Fellowship were read:—For the first time, in favour of Cecil Henry Hooper, Boris Petrovich Uvarov, Randolph Gordon Ridling, and Eileen Sutton.

The following candidates were balloted for and elected Fellows:—Charles Edmund Ford, B.Sc., Henry Alexander Lindeman, Mrs. Menie Watt, Colonel Lionel Hugh Knightley Finch, Ralph Ellis, Frederick William Andrews, B.Sc., Amos Perry, V.M.H., Terence Charles Stuart Morrison-Scott, B.Sc., Sir John Reeves Ellerman, Bart., Andrew William Ernest Soysa, M.B., M.R.C.P., M.R.C.S., and Brian Seymour Vesey-FitzGerald.

A remarkable new Gallinaceous bird from the Belgian Congo.

[Exhibit.] By DR. JAMES P. CHAPIN, American Museum of Natural History, New York.

WHILE in the Ituri Forest in 1913 I was interested in the feathers worn on the hats of native men, since some were of birds that I had not found there. Some of these feathers I acquired and preserved. One proved to be from *Bubo shelleyi*, no specimen of which has yet been collected in the Belgian Congo, and another remained unidentified till this present year. Its form indicated that it was a secondary remex of a gallinaceous bird, probably larger than a guinea-fowl, and its colour was rufous with blackish bars. Thinking it might have come from a hybrid between a chicken and a guinea-fowl, I compared it with such hybrid specimens in New York, but there was no agreement. No one to whom I showed the feather could suggest a bird from which it might have come.

During the past summer, at the Congo Museum, Tervueren, Belgium, I happened to walk through a room never occupied by bird collections, and there found two strange gallinaceous birds, one of which had barred wing-feathers like the one I had preserved for twenty-three years. These two mounted specimens were received from the museum of the Compagnie du Kasai in 1914. Being then labelled as domestic peacocks, they were put neither in the exhibition cases nor in the study collection, but were set away in the room where I found them.

My friend Doctor H. Schouteden, Director of the Museum, suggested that I study them, and name the species if new. It did not take long to determine that we had to do with an unnamed species and genus of phasianid, more nearly

allied to *Pavo* than to any other of the family. For it I chose the name *Afropavo congensis*, and the description was published in the 'Revue de Zoologie et de Botanique Africaines' on November 20, 1936.

Although allied to the peacocks, this new 'Congo peacock' has neither eye-spots nor train. The adult male is largely blackish, browner on the back, with a weak green lustre on the back, and brighter violet gloss on the neck, wing-coverts, and tip of the tail. The supposed adult female is a rufous-brown bird, largely barred and marbled with blackish, and with brilliant green gloss over the whole back. Both sexes have narrow upright crests on the back of the crown, and on the middle of the crown a curious roughened patch from which rise tufts of whitish bristles.

There is no record of the locality from which the specimens came, and we can only suspect that they were trapped by natives in the vicinity of the upper Lukenie River. The only locality at which we know the bird to exist is Angumu in the eastern Congo forest, where M. de Mathelin de Papigny tells me he ate one in 1930. It must be rare and local in its distribution, an inhabitant no doubt of heavy forest. We are doing our best to stimulate the collecting of further specimens.

In reply to a suggestion by Mr. N. B. KINNEAR that additional specimens might be needed to establish the exact relationships of *Afropavo*, Dr. Chapin added that he had made sure of its being a pheasant and not a guinea-fowl by examining the second metacarpal in the supposed female specimen. The protuberance which distinguishes the phasianids seems not to be well developed in young birds, so its condition in this example indicated that we had to do with an adult female, not a young male. He had long been familiar with the external characters of most of the genera of pheasants, and to him none save *Pavo* seems at all closely allied.

The President also spoke.

An unusually large skull of the Giant Forest Hog (*Hylochoerus meinertzhageni*) from Gilgil, Kenya Colony, presented to the British Museum (Natural History) by N. R. C. Warwick, Esq., M.V.O., O.B.E. [Exhibit.] By Capt. GUY DOLLMAN, F.L.S.

CAPTAIN DOLLMAN exhibited the skull of an exceptionally fine specimen of the Giant Forest Hog (*Hylochoerus meinertzhageni*), which the British Museum had received as a donation from Mr. N. R. C. Warwick, M.V.O., O.B.E., who collected the specimen at Gilgil, Kenya Colony, some few years ago.

This skull, it was pointed out, was the second largest *Hylochoerus* skull to be received by the Museum, and was that of a very old male with tusks of nearly record size.

Captain Dollman recalled that the first rumours and reports of the existence of a large pig inhabiting the forests of Central and East Africa were current in the days of Stanley and Emin Pasha, and that these reports were echoed by the late Sir Harry Johnston, who thought they might possibly refer to an eastern form of the Pigmy Hippopotamus. Further information concerning the existence of such a pig was supplied by the late Sir Frederick Jackson, and at about the time of the discovery of the Okapi further rumours of an East African pig as large as a small rhinoceros were prevalent. It remained for Colonel Meinertzhagen to furnish proof of the existence of such a pig by discovering in the year 1904 a perfect skull, together with fragments of skin, of what is now known as the Giant Forest Hog. In addition to these specimens, which were collected in the Nandi Forest area, a forest lying E.N.E. of the Victoria Nyanza at an altitude of 7000 feet, Colonel Meinertzhagen also sent home a broken skull from Mt. Kenya. On these specimens the late Oldfield Thomas founded a new genus, *Hylochoerus*, and named the species *meinertzhageni* after the discoverer. The natives who collected these specimens asserted that this pig was hardly ever found out in the open, but kept to the dense forest—a fact, which probably accounts for its delayed discovery.

Two further species of *Hylochoerus* were described in 1906, one by Oldfield Thomas and the other by Dr. P. Matschie, of the Berlin Museum. The species founded by Thomas, described before Matschie's description was published, was a West African Forest Hog from the Cameroons distinguished from the typical *meinertzhageni* by its smaller size and smaller cheek-teeth. Capt. Dollman thought that this West African Forest Hog would appear to be a subspecies of the East African form, and its name should therefore be *Hylochoerus meinertzhageni rimator*.

Dr. Matschie's species, *Hylochoerus ituriensis*, came from the Ituri Forest in the Eastern Belgian Congo. It also was a smaller animal than the typical East African Forest Hog. The figures illustrating the paper show that the large facial warts are not so markedly developed as in the typical form; but this absence of warts would appear to be a character associated with juvenility, because the Forest Hogs collected recently by the Howard de Walden Expedition in the Ituri Forest had the normal fungus-like development of these growths. From the evidence at present available it would appear that *ituriensis* is nothing more than a subspecies of *Hylochoerus meinertzhageni*; indeed, it might be regarded, perhaps, as identical with the West African *rimator*.

It was pointed out that the genus *Hylochoerus* was in many ways intermediate between *Potamochoerus*, the Bush Pigs, and *Phacochoerus*, the Wart Hogs, the molar teeth of *Hylochoerus* being somewhat of the brachyodont type of *Potamochoerus*, while the upper canine teeth were similar in many respects to those of the Wart Hogs; furthermore, the genus agreed with *Phacochoerus* in possessing only a single pair of upper incisors. The skull in many ways resembles that of *Sus* and *Potamochoerus*, but the depression of the frontal region and low occipital development would seem to suggest a relationship with *Phacochoerus*. The molar teeth, while resembling those of *Potamochoerus* to a certain extent, probably foreshadowed the evolution of the specialized hypsodont teeth of *Phacochoerus*.

The chief external features of this Pig were said to be the large blunt terminal disc to the muzzle and the fact that warts behind the tusks, present in the Wart-Hog, were absent in this species. Further, the warty growths, or excrescences, below the eyes were very much more conspicuous than the warts of a Wart-Hog, and reminded one, both in their appearance and their pink coloration, of a fungus-like growth. Lastly, the coat in the Forest Hog was much more profuse and the skin and hair were jet-black.

Dr. J. C. CHAPIN stated that photographs of *Hylochoerus* had recently been taken by Mr. Léon Lippens (of Brussels) in the Ruindi Plain near Lake Edward. While there were small patches of woods nearby, the pigs were out in an open grassy situation, very surprising to those who know *Hylochoerus* as an inhabitant of heavy forests like the Ituri. This may help to explain, nevertheless, the occurrence of the black forest hog in relatively small forested areas in eastern Africa, separated by wide areas of open country. He was informed that one or more specimens of *Hylochoerus* have since been collected near the place where Mr. Lippens took his photographs.

Naturally shed Elephant molars. [Exhibit.]

By T. C. S. MORRISON-SCOTT, B.Sc.

MR. MORRISON-SCOTT exhibited a pair of molars from the lower jaw of 'Jumbo II', a Sudan Elephant at the London Zoological Gardens. These molars, one from each side of the jaw measured 55×33 mm. and the ridge formula was 7 in each, including strongly developed 'talons'. The teeth were shed on 21st and 22nd Feb. 1936; the word 'cast' would be more appropriate since the elephant pulled the teeth out with his trunk and threw them at visitors.

At this time the elephant was about three and a half years old. Mr. Morrison-Scott pointed out that this occurrence was worth recording, as there was no note of the age at which African elephants shed their teeth, and this instance would be of interest when making estimates of the age of any particular African elephant and of the age to which these elephants live. The 'ridge formula' for African elephants, as recorded by Lydekker and Weber, is 3, 6, 7, 7, 8, 10. The molars referred to above are the second ones in each series of six; this much is established without a doubt on account of their size, and from examination of young skulls. It will be seen therefore that according to the formula 3, 6, 7, 7, 8, 10 these molars should have 6 ridges.

This discrepancy had led him to investigate the origin of the ridge formula, and he finds it is attributable to Falconer. He, however, meant 'the number of ridges not counting talons'. For some reason or other it has become a tradition to refer to the first and last of the enamel lamellae or ridges as 'talons', which some authors include in their ridge formulae and others do not. The development of the 'talon' is very variable, and though it may only be a very small affair, it may also be almost as big as the other ridges.

The formulae as quoted by Lydekker and Weber fail to mention that the figures represent the total number of ridges minus two, and it is this which in his opinion had led to the 'pigmy elephant' myth. Small elephants have been shot and have been assumed to be adult because their molars showed 9-10 ridges. But when 2 have been deducted as 'talons' the number of ridges becomes 7-8, which shows that the elephant is not necessarily full grown. What is more, examination of the skulls of 'pigmy elephants' shows that the bones are by no means completely fused, and, further, from an examination of skulls in the British Museum it seems likely that the teeth in question are either the third or the fourth, and not the fourth or fifth as the formula, when correctly read, would suggest.

These facts suggest that the ridge formula for the African elephants needs revising, and he expressed his intention of examining much more material with a view to establishing the limits of variability in the number of ridges in each molar.

Mr. Morrison-Scott also exhibited a right lower molar from an Indian elephant used by Mr. C. G. Rogers in 1908 when Conservator of Forests, Berar Circle, C.P. The molar was broken off while the elephant was breaking fig branches to eat. The molar, while being held in the jaw by its posterior end, must have projected beyond the gum for 5 inches, since not only is the crown worn, but *also the roots*, which have

been polished away till a second ridge pattern is visible on the opposite side of the tooth from the crown for a distance of 5 inches from the anterior end.

It is astonishing that this projecting portion of the tooth should not have been broken off before. The corresponding molar in the upper jaw must have been missing or broken to allow the lower molar to grow up out of the jaw without being worn away.

The wear on the side of the tooth opposite to the crown was probably occasioned by the process of pulling branches through the mouth to strip off the bark.

Dr. J. C. CHAPIN stated that the subject of elephant dentition has an important bearing on the question of sub-specific distinctions within the species of ordinary African elephant and the possible existence of a pygmy elephant. Many remain unconvinced as regards the pygmy species, and he felt that now is the time to clear up the doubts about African elephants.

His suggestion for some years past had been that a young man thoroughly trained in elephant anatomy and dentition should go to Africa and collect the material needed for a thorough understanding of its elephants. Under proper guarantees, he felt sure that the colonial administrations, especially that of the Belgian Congo, would grant the needed co-operation; and this investigation ought certainly not to be deferred until elephants become further reduced in numbers.

The British Museum Expedition to the mountains of East Africa. By Dr. GEORGE TAYLOR, F.L.S.

THE expedition visited four groups of mountains during the period October 1934 to March 1935, the Aberdare Mountains and Mount Elgon in Kenya, and the Virunga Mountains and Ruwenzori in Uganda, to make a study of the flora and insect fauna of these regions, and to discover if any comparable peculiarities existed between the plants and insects. It is impossible, as yet, to present an analysis of the flora, since the collections are still largely undetermined, and any observations at this stage must be provisional and subject to future emendation.

To a visitor probably the most striking features on these mountains are the altitudinal zonation of the vegetation, and, in the alpine zone, which one usually associates with low supine growth-forms, the presence of arborescent or gigantic forms in genera normally much less robust. In this respect the genus *Senecio* is of particular interest, since its

arborescent representatives are confined to the East African mountains, for while the giant *Lobelias* also form a conspicuous feature of this vegetation they are not restricted to Africa or even to its alpine regions.

The altitudinal zones tend to be repeated on each mountain mass, though with certain modifications, and their range and constituent species vary even on different sides of the same mountain. This is perhaps most evident, as has already been recorded by the British Museum Expedition of 1905–1906 and a recent Belgian Expedition, on Ruwenzori where the difference of climate on each side is considerable. Further, on the eastern flanks of Muhavura (Virunga Mountains) there is no bamboo forest, but on the western side and adjoining mountains there is a dense belt of bamboos, while on Kilimanjaro bamboos are entirely absent.

Our knowledge of the climatic factors on the East African mountains is still far from complete, and observations at the higher altitudes have been confined to relatively short periods. High altitude with rarification of the atmosphere, insolation of a tropical sun, presence of cloud, length of day and night, all influence the vegetation, but perhaps the most important factors are the prevalence of fairly uniform conditions throughout the year with little fluctuation around a low mean temperature, and the strongly acid substratum.

The flora of the East African mountains may be said to be fairly well known, and it is surprising that no further comprehensive analysis of its elements and their geographical relationships has been worked out since the publication of Engler's 'Hochgebirgsflora des Tropischen Africa' in 1892. At that time no collections were available from Ruwenzori, the Virunga Mountains, Mount Elgon, or the Aberdares. Hauman has published an invaluable account of the flora of western Ruwenzori, and together with several accounts of other mountains and the material and records now available, a reasonably complete analysis could be attempted.

The mountains have many species in common, and this is particularly true of the lower zones, where *Lobelia Gibberoa* may be mentioned as a species occurring in the forest on all the groups. At the higher elevations, or above the heath forest, not only are the species much fewer, but show a marked tendency to specialization. Evidence of this is found in *Senecio* and *Lobelia*, whose species tend to be restricted to individual mountains or groups of neighbouring mountains. No arborescent *Senecio* or giant *Lobelia* of the highest altitudes is known to be common to mountains on both sides of the Rift Valleys.

The relationships of the floras of the individual mountains must await further investigation, but some preliminary

observations may be made. Certain significant species and genera, all it may be noted essentially temperate, are common to the alpine zones of all the mountains (*Juncus bachiti*, which is also found in Abyssinia and the Marra Mts. of Darfur *, *Koeleria cristata*, *Deschampsia flexuosa*, *Anthoxanthum nivale*, *Scirpus setaceus*), showing that there is a strong affinity between all these alpine floras, although closer mutual relationships are apparent. The Virungas and Ruwenzori have the following species in common: *Senecio Erics-Rosenii*, *Lobelia lanuriensis*, and *L. Wollastonii*. No species of arborescent *Senecio* or giant *Lobelia* occurring on the Virungas and Ruwenzori, other than the forest species *L. Gibberoa*, is to be found on the other East African mountains. Of the eastern mountains Kilimanjaro and the neighbouring Meru appear floristically to be the most isolated, since their representation of these genera are all local endemics. Mount Elgon, Kenya, and the Aberdares are linked by the common occurrence of *L. aberdarica* and *L. Telekii*, but the closer relationship of the Aberdares and Kenya is emphasized by the common occurrence of *L. bambuseti* and *S. Battiscombei*. The flora of Elgon, Kenya, and the Aberdares has strong affinities with the mountains of Abyssinia, the same species are often common to these areas.

A striking feature of this montane flora is the presence of so many genera, and even species, which are otherwise essentially temperate. As examples the following may be quoted:—*Ranunculus*, *Delphinium*, *Arabis*, *Subularia*, *Cardamine*, *Cerastium*, *Lathyrus*, *Callitriche*, *Anthriscus*, *Sanicula*, *Dipsacus*, *Limosella*, *Urtica*, *Alisma*, *Luzula*, *Aira*, *Calamagrostis*, *Anthoxanthum*, *Koeleria*, *Poa*, *Festuca*, *Bromus*, *Lolium*, and *Deschampsia*. These are almost entirely confined to the higher altitudes, although *Sanicula europaea* is a species which is abundant in the lower forest zone. The occurrence of these temperate genera has naturally been a matter of much speculation. Engler believed that several of these African representatives differed from the European in slight characters, and suggested that originally the plants were distributed by wind or by birds of passage during a former pluvial period. It seems that some other reason must be sought for the isolated occurrence of these genera on each group of mountains, and it may be pointed out that now, at any rate, the higher elevations where the plants occur appeared to be very deficient in bird-life †. Very rarely

* This species has not hitherto been recorded from the Anglo-Egyptian Sudan. Material was collected by J. E. Dandy (n. 124) in 1934 on the western side of the Marra Mts. at about 2300–2700 m. altitude.

† The British Museum Expedition of 1905–1906 recorded only seven species of birds above 12,500 ft.

species of duck were seen, and swifts, hardly to be associated with plant dispersal, were seen at 14,000 ft. on Ruwenzori.

It is probable that the occurrence of these temperate elements on the East African mountains can best be explained from a comparative study of the past climatic history of the region, and happily our knowledge of this has been greatly advanced recently by the work of Leakey, Nilsson, and Wayland. The basic fact of the contemporaneity of the Pleistocene epoch throughout the world is now generally accepted by geologists. When the northern ice-sheet attained its climax, the glaciers on the African mountains also reached their maximum and extended far down the valleys. While anticyclonic conditions prevailed in the immediate vicinity of the ice, moister conditions existed in the intervening areas. There is abundant evidence of former pluvial periods in East Africa, and during these the climate must have been much cooler and probably of a temperate type. The climatic belts were displaced with corresponding disturbance of the vegetational zones. There is evidence that at that period Palestine, Egypt, the Sahara, and the plains of E. Africa enjoyed climate of a temperate type, and thus plants pushed down by the northern ice-sheet were able to pass into Africa, although the occurrence of European species in these parts during this period still awaits confirmation from fossil evidence*. With the retreat of the ice and dispersal of pluvial conditions, the temperate species either perished or sought suitable conditions by ascending from the plains to an altitude where survival was possible.

The close connection between the forests of Uganda and those of West Africa is well known, as is also that between the vegetation of Ruwenzori and Cameroons Mountain, but the relationship of the forest flora of Ruwenzori and the Virunga Mountains with that of the islands of the Gulf of Guinea is sufficiently striking to deserve special mention. It is exemplified by the two genera *Thunbergianthus* and *Pseudagrostistachys*, which are confined to these two regions. *Thunbergianthus*, as at present interpreted, comprises two species, one found on the island of S. Tomé, the other confined to Ruwenzori. *Pseudagrostistachys* has a single species on S. Tomé and Fernando Po and two others on the Virungas.

Other plants of phytogeographical interest found on the mountains of East Africa are *Sambucus adnata*, which also occurs along the Himalayas into south-western China, *Swertia* spp., representatives of a genus which is predominantly Sino-Himalayan, and *Canarina*, which is otherwise known only from the Canary Islands and Abyssinia.

* The record of *Quercus Ilex* from the Kharga Oasis in central Egypt has been disproved, and the leaves on which the record was based have been identified as *Ficus ingens*. See E. W. Gardner in Quart. Journ. Geol. Soc. Lond. cxi. 510 (1936).

Dr. J. C. CHAPIN said that, as one who has visited several of the mountain ranges so admirably described by Dr. Taylor, he was deeply interested in the story of his expedition and congratulated him on its important results. Inasmuch as they both found the weather on Ruwenzori decidedly favourable toward the month of December, this would seem to be the best season for visiting those mountains.

Ruwenzori has great contrasts in the humidity or aridity of districts around its base. At Katwe the salt lake indicates that annual precipitation does not exceed evaporation, while in the middle Semliki Valley the rainfall is sufficient for the development of heavy lowland forest.

The natives of the region all recognize a connection between the mountains and rainfall. But, whereas Dr. Taylor's porters erected a 'ghost hut' to ward off rain, the natives on the western base of Ruwenzori go up on the mountains and build ghost huts to obtain the rain needed on their farms lower down. On western Ruwenzori he saw wooden whistles blown to drive away rain-clouds, but their efficacy seemed to be nil.

Mr. A. W. EXELL said that Dr. Taylor's collections were as excellent as the slides which had just been shown and that Fellows would realize that no greater compliment could be paid them. It was the finest collection from the East African Mts. ever received at the British Museum. Although not yet completely worked out it was evident that there were a number of interesting new species, and that the well-preserved material would enable us to clear up many problems. As regards the remarkable connection with the flora of S. Tomé mentioned by Dr. Taylor, it was evident from the slides that the Ruwenzori forest was markedly similar to that of the mountain-forest of S. Tomé in the extraordinary development of epiphytes and in the climatic conditions, particularly the constant mist and almost continuous rainfall. The genus *Thunbergianthus* seemed to be a clear and remarkable case of discontinuous distribution. *Pseudagrostistachys*, the other example mentioned by Dr. Taylor, was also striking; but he considered it possible, since the flowering period seemed to be short and the tree was not particularly noticeable when not in flower, that it would be discovered on Cameroons Mt., especially as it had already been found on Fernando Po.

Mr. E. G. BAKER asked Dr. Taylor about the fertilization of the Giant Lobelias. He congratulated Dr. Taylor on the very fine collection he had made.

Mr. C. GILBERT ROGERS (who exhibited a three-year old living specimen of *Lobelia Telekii* grown out of doors at Etchingham, Sussex) said he had been on the northern

slopes of the Kibo peak of Kilimanjaro, up to 9,000 feet in the month of November, immediately after heavy rain, in fine weather; and again in February, when he camped close to the Kimengalia stream, above Rongai, at an elevation of about 9,000 feet for a week, and reaching a height of over 12,000 feet. On both occasions he had fine weather. He also went up the northern slopes of Mount Kenya, camping at an elevation of about 12,000 feet in the Sirimon valley, for a week, and going up to an elevation of 14,000 feet, in the month of June. With the exception of one very heavy hail-storm, he had fine weather.

The rainfall in Kenya Colony, in any one month—even in the seasons of the year when rain does not usually fall—varies so much from year to year that it is not possible to reckon on having fine weather in any month of the year. One had to watch for one's opportunity, and go up the mountains when the weather seemed likely to be fine.

On the northern slopes of both Kilimanjaro and Kenya the evergreen tree high forest stops abruptly, without any apparent reason, at an elevation of about 7,000 feet on Mount Kibo, and nearly 10,000 feet on Mount Kenya; giving place to a low scrub forest, with many blanks and rocky barren places in it. This scrub forest is succeeded by grass, dwarfed woody plants only a few inches high, and herbs, extending up to 14,000 feet, or even higher, in the shelter of rocks.

Only one species of giant *Lobelia* was found in flower on Mount Kibo, *L. Deckenii*, which, however, had two very distinct varieties, one growing in a swamp at an elevation of 10,000 feet, and the other on a dry rocky ridge 2,000 feet higher. On Mount Kenya two other species were found, *L. Telekii* and *L. keniensis*, growing at elevations of from 11,500 to 13,000 feet. The former in drier localities, as a rule, and at higher elevations; and the latter in what are swamps in the wetter portions of the year. Occasionally the two species were found together in the higher and drier portions of the swampy areas.

Only one small lake was seen in the alpine portion of the Sirimon stream, hidden away among rocks, at the foot of a high rock bluff, at an elevation of 13,000 feet. The bottom of the lake was destitute of vegetation. There was no visible outlet from it; the water seeped away. The banks, all around, were undercut by wave action. There was a regular field of *Senecio Brassica* around the northern side of this lake.

No tree *Senecios* were seen on the northern slopes of Mount Kibo; but on Mount Kenya *S. keniodendron* was common from 12,000 to 14,000 feet. It formed extensive, open, pure, forest on a flat-topped ridge (elevation 13,000 feet) running due south from the opposite side of the valley, where

our camp was, towards the peaks, forming the top of the mountain. This species occurs, singly, or in small groups on some of the isolated stony hills and rock masses. Only one specimen was found in flower; but dead stems, hanging down, among the persistent dead leaves, which form a protective covering to the main stem, were common. Two other tree *Senecios* were common; one about 12,000 feet, just overlapping *S. keniodendron*, and the other from 9,500 to 10,000 feet, in the upper fringe of the evergreen high forest and the lower part of the succeeding low scrub forest.

On Mount Kibo, one passed through a zone of lichen-covered trees in the lower part of the scrub forest, similar to that described by Dr. Taylor on Ruwenzori. This belt was absent from the northern slopes of Mount Kenya. No bamboos were seen on Mount Kibo; but one passed through a belt of bamboos on Mount Kenya, not far from the upper limit of the evergreen high forest.

Professor F. E. WEISS and Dr. A. B. RENDLE also spoke.

In reply to Mr. Baker, Dr. TAYLOR stated that the *Lobelias* and *Senecios* are regularly visited by sun-birds and these are apparently responsible for the pollination of these plants. To Professor Weiss, Dr. Taylor replied that Dr. Hauman, of the Belgian Expedition, has expressed the opinion that *L. Wollastonii* does not reach maturity in less than forty or fifty years.

10 DECEMBER 1936

Dr. W. T. CALMAN, C.B., F.R.S., President,
in the Chair

The Proceedings of the General Meeting held on Thursday, 26 November 1936, having been circulated, were taken as read and confirmed.

The President reported the death of Dr. Lilian Jane Veley, a Fellow of the Society.

A list of names of those who had made gifts to the Library since the previous meeting was read and laid on the table.

The following Fellows signed the Obligation in the Book of the Charter and Bye-Laws and were admitted:—Brian Seymour Vesey-FitzGerald, Col. Lionel Hugh Knightley Finch, Terence Charles Stuart Morrison-Scott, Sir John Reeves Ellerman, Bart., and Ralph Ellis.

Certificates of recommendation of the following candidates for Fellowship were read :—For the second time, in favour of Cecil Henry Hooper, Boris Petrovich Uvarov, Randolph Gordon Ridling, and Eileen Sutton; for the first time, in favour of Gian Singh Bhatia, Harold Geoffrey Wager, the Hon. William Jocelyn Lewis Palmer, and Margaret Trevena Martin.

Great game animals of Africa.

By Captain GUY DOLLMAN, F.L.S.

CAPTAIN DOLLMAN gave a lecture on the Great Game Animals of Africa illustrated by lantern-slides made from photographs taken by the late Marius Maxwell, Fellow of the Society, the well-known big-game hunter and photographer. Captain Dollman said :—

‘ My remarks to-night concern the great game animals of Africa and will be illustrated by a series of slides made from photographs taken by the late Marius Maxwell. Mr. Maxwell was killed in an aeroplane accident on November 2nd last while piloting his own machine. He had taken up flying only about twelve months ago and after a few hours solo flying undertook the flight from Marseilles to Kenya which he achieved successfully. We are concerned to-night with Maxwell’s work not so much as a big-game hunter but as a big-game photographer, an art in which he excelled, and the photographs which I have to show you are those which illustrated his *magnum opus* entitled “ Stalking Big Game with a Camera ”. A limited edition of this book was published in 1924 by the Medici Society, to be followed a year later by a cheaper edition, which has since gone all over the world. In addition to Maxwell’s work in connection with the photography of East African game animals, he also visited the Birunga Volcanoes, lying north-east of Lake Kivu, to study the habits and to photograph the eastern Gorilla and its surroundings; this expedition was conducted in the year 1925 and the results of it were embodied in a paper published in the “ Journal of the Bombay Natural History Society ” of 1928.

‘ To-night we are concerned only with Maxwell’s photographic expeditions to Kenya Colony, and here we are more or less confined to two localities, firstly, down in the Masai Reserve close to the old German border, between the Amala and Mogor rivers, and, secondly, up in the northern Frontier Province along the Northern Guaso Nyiro.’

The animals dealt with were the elephant, rhinoceros, giraffe, buffalo, and hippopotamus, most of the slides being concerned with the elephant. The lecturer commenced by giving the distinguishing points between the African and

Indian elephant, and went on to describe the senses, the food, and the utterances of the African species. This was followed by an account of the elephant in attack, of the so-called elephant cemeteries, and of the distribution of the elephant in Africa at the present day.

The rhinoceroses were dealt with in some detail, both those of Asia and Africa, and reference was made to the record specimen of the Javan rhinoceros (*Rhinoceros sondaicus*) which was shot and presented to the British Museum (Natural History) by Mr. Maxwell some years back. The white rhinoceros and black rhinoceros of Africa were shown on the screen, and an account of the tick-birds which infest these animals was likewise illustrated. Numerous photographs of giraffes were shown, and the various movements of the animals while galloping were described.

Two striking photographs of buffalo accompanied a description of this species, and Captain Dollman pointed out the risk which Mr. Maxwell must have taken to secure such 'close-ups' of such a dangerous animal. The lecture concluded with some further slides of elephants and a series of most interesting views of hippopotamuses, including two slides of a young hippopotamus photographed, firstly, while asleep on the bank of a river and, secondly, trotting down to the water's edge, having been disturbed by the sound of the camera shutter. The last of the elephant photographs were very impressive, and were taken by Mr. Maxwell at a very short range while he was standing right out in view of the elephants.

The lecturer emphasized the fact that big game and civilization could not continue side by side for all time, and that one or the other must disappear. He drew attention to the various species of big game that have been exterminated during recent times and others that were on the verge of extinction, such as the white rhinoceros of South Africa and its cousin the Javan Rhinoceros of the East Indies. Therein he thought, the importance of photographic records of wild animal life would lie, in that, centuries hence, posterity would possess these records, records of a world as strange to it perhaps as that of the cave-bear and mammoth are to us to-day.

Dr. E. B. WORTHINGTON asked if Capt. Dollman had information on the gestation period and reproductive periodicity of African elephants, because on this must depend policy in the control of elephant populations in several parts of Africa. An object of game authorities is to maintain a stable population of elephants if such is compatible with the interests of agriculture, and for this purpose the numbers killed should, of course, equal the natural increase. A second

point referred to the hippopotamus, which the late Mr. Maxwell's magnificent photographs mostly showed on dry land. Dr. Worthington suggested that hippos now spend nearly all their time in water because there are so few parts of Africa near lakes or rivers which are devoid of human population. Where population has been entirely removed, through outbreaks of sleeping sickness or other cause, it is common to find hippos spending a large part of their time out of water. This raises the question of which came first—the aquatic modifications of the hippopotamus or the aquatic habits?

Captain DOLLMAN replied that the difficulty was in collecting such evidence.

Some types of Australian vegetation from the centre to the sea. By Professor T. G. B. OSBORN, F.L.S.

A SERIES of lantern-slides was shown illustrating the vegetation from the MacDonnell Ranges in Central Australia along a line some 1300 miles long to the coast at Sydney.

The MacDonnell Ranges lie immediately south of the Tropic of Capricorn. The rainfall is about 10 inches. The Burt Plain, immediately north of the Ranges, has a scrub of *Acacia aneura* (Mulga) with tussock grasses (*Andropogon*, *Aristida*, &c.). In the Ranges is an open scrub of scattered trees, *Acacia* spp., *Grevillea* spp., *Capparis* sp. with occasional woodland of *Eucalyptus terminalis* in positions of more favourable water relations. The water-courses, dry except after occasional rains, are lined by *Eucalyptus rostrata*. A feature of special interest is the relic flora found in a few narrow E.-W. running valleys protected by high precipitous cliffs. On the south-facing talus slopes of these occur *Callitris robusta*, *Ficus* sp., *Tecoma australis*, and *Macrozamia MacDonnellii*. *Livistonia Mariae* occurs abundantly in the stream-beds.

South of the Ranges is an extensive peneplain dipping slowly from 2000 ft. to below sea-level at Lake Eyre, which is in the driest part of Australia (under 5 ins. annual rainfall). The greater part of this is open steppe with low shrubs, under 1 ft., of *Atriplex*, *Bassia*, and *Solanum* spp. Wind-sorting of the soil has produced extensive areas of sand-hills (e.g. Depot sandhills and north of L. Eyre). The former are clothed with *Triodia* sp. The areas of better water relations at their foot may have shrubs of *Acacia*, *Cassia*, *Eremophila*, &c. The river-beds, usually dry, are lined by *Eucalyptus rostrata* with an outer fringe of 'river boxes', e.g. *Eucalyptus microtheca*, on the flood-plain. Smaller water-courses on the low hills are lined by *Acacia Cambagei* or *A. cyperophylla*. Extensive 'gibber' plains (a *reg desert*)

are bare except for ephemerals. Local open woodlands of *Casuarina Decasaina* (trees to 40 ft.) are an unexpected woodland development on an area with only an 8 in. rainfall.

South of the Lake Eyre region and east of the Flinders range the land rises gradually to about 1000 ft. along the Olary ridge and to the Barrier Range, Broken Hill. There are two distinct vegetation types here, extensive shrub-steppes on mature soils and open scrub on the immature soils of the hills. The dominant over extensive areas of steppe is *Atriplex vesicarium*, the perennial saltbush. Other species of *Atriplex* also *Bassia* and *Kochia* spp. occur. These steppes are non-halophytic. Halophytes are found round the various lake beds (e.g. Lakes Eyre, Torrens, and many smaller centres of inland drainage). The scrub on the hills has trees of *Acacia aneura*, *A. tetragonophylla*, *Casuarina lepidophloia* and shrubs of *Acacia*, *Cassia*, *Eremophila*, *Dodonaea* spp.

Throughout the whole arid and desert regions, except fringing the dry river-beds, Eucalypts are rare.

With increasing rainfall (10-12 ins.) mallee Eucalypts (e.g. *E. oleosa*) come in over the plants of the steppe. Finally, with a rainfall of about 12 ins. having a winter maximum, the plants of the steppe disappear and mixed sclerophyllous shrubs occur with the mallee. The ecotone lines in this region are very narrow.

Progressing S.E. from the Barrier Range and crossing the Darling River the transition from arid to semi-arid vegetation occurs more gradually. The rainfall gradually increases to 16-20 ins., but with no definite seasonal maximum. The terrain is generally level, being the basins of the Darling, Lachlan, and Murray rivers. Steppe is replaced by scrub woodland, in which the Eucalypts are mingled with such trees as *Casuarina lepidophloia*, *Geijera parviflora*, *Acacia* spp. With increasing rainfall, 20 ins. plus, a savannah woodland of 'box' Eucalypts (*E. conica*, *populifolia*, *melliodora*) occurs. These have been extensively cleared for sheep and wheat farms. The rivers are still fringed with *Eucalyptus rostrata*, but from Forbes eastwards this is replaced by *Casuarina Cunninghamii*, which is the dominant riparian tree across the Dividing Range to the coast.

The western slopes of the Great Dividing Range are more gradual than the rather precipitous eastern. They have been extensively cleared for farming, but still show open Eucalypt forest (*E. polyanthemos*, *E. melliodora*, *E. Stuartiana*, *E. Woollsiana*).

On the Dividing Range (rainfall 40-60 ins.) sclerophyll Eucalypt forests occur with characteristic shrubby undergrowth (various *Acacias*, *Papilionatae*, *Rutaceae*, *Proteaceae*). Shrubs in a great number of species are a special feature

of the earlier successional phases. Under conditions of favourable water-relations wet sclerophyll forest occurs with tree ferns (*Alsophila*). In specially sheltered places, i.e. deep valleys or soils with a high water-retaining capacity, rain-forest 'brush' may develop. The dominants here are not Eucalypts, but such trees as *Ceratopetalum apetalum*, *Doryphora sassafras*, with *Vitis* spp. as lianes. The junction between Eucalypt forest and 'brush' is often very abrupt.

Sclerophyll forests occur on the eastern side of the Dividing Range to the coast. There are several types associated with edaphic and physiographic changes in the environment. Rain-forest may occur in favourable places to the coast. There are relics of it near Sydney (46 ins. annual rainfall). The successional phases of these forests and their inter-relations are being investigated by the Botany School, University of Sydney.

Sclerophyll forests develop in the sequence from mangroves (*Avicennia*→*Salicornia* meadow→*Casuarina glauca* swamp forest→*Eucalyptus robusta* forest). The sequence on the sand-dunes also progresses to a sclerophyll forest, *Eucalyptus pilularis*, *E. haemastoma*, and *Angophora lanceolata*.

Mr. C. E. HUBBARD asked Professor Osborn if he would give some information on the root-system of the species of *Eucalyptus* which grow in Central Australia, as it was understood that roots of *Eucalyptus* sp. had been taken from the bottom of a well 250 feet deep.

Mr. JOHN E. ADLARD remarked that Professor Osborn showed photographs of very typical Australian country; but that he (Mr. Adlard) was not familiar with New South Wales, but rather Victoria. He noticed that the flowering Acacias—Wattles—were not apparent.

Mr. J. RAMSBOTTOM commented on the fact that many botanists present probably had revised their ideas on Australian vegetation during Professor Osborn's very clear and well-illustrated account. For himself he had been particularly delighted to see the last slide, the coloured one showing Botany Bay, for it was there that Australian botany began. The plants collected by Banks and Solander in 1770 may be seen in the Department of Botany, British Museum, together with other historical Australian botanical material.

Mr. M. A. C. HINTON also spoke.

Replying to Mr. Hubbard, Prof. OSBORN stated that the Eucalypts of the arid regions had a markedly superficial root system, the spread being 100 ft. or more in diameter. Strong vertical roots were exposed in many river banks, but, so far as he knew, the root-systems had not been carefully

excavated. Stories of Eucalypt roots found at considerable depths were commonly heard from well sinkers; such root penetration was obviously different from root growth down a well shaft already sunk.

Replying to Mr. Adlard, Prof. OSBORN said that *Acacia* spp., as trees or shrubs, were commonly found over the whole long line that he had described, but heavy flowering 'wattles' (e.g. *A. decurrens*) were only found along the last 200 miles or so, nearing the coast. Even these were probably only prominent in Eucalypt forests after fire or in other secondary succession-phases.

